ALCOHOL AND THE HUMAN BODY

HORSLEY AND STURGE

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ALCOHOL AND THE HUMAN BODY

AN INTRODUCTION TO THE STUDY
OF THE SUBJECT

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THE HUMAN BODY

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BY

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WITH A CHAPTER

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"Vigorous health and its accompanying high spirits are larger elements of happiness than any other things whatever, and the teaching how to maintain them is a teaching that yields in moment to no other whatever."

HERBERT SPENCER.

"For complete living it is necessary that there shall be escaped the incapacities and the slow annihilations which unwise habits entail."

Ibid.

PREFACE

In the preparation of a work of this character, however small, the essential necessity of obtaining the most reliable information is obvious. Fortunately the care and accuracy with which the statistics of our Public Bodies are now kept provides workers in Science with a mine of information which, owing to the public spirit of their officials, has been placed at our disposal.

We are thus indebted to the Asylums Committee of the County of London, to the Metropolitan Asylums Board, to the Infirmary of the Wandsworth Union, to the Salisbury Infirmary, and to the following London Hospitals: St. Bartholomew's, Guy's, Westminster, St. George's, St. Mary's, Middlesex, and University College Hospital.

To Dr. Newsholme, who has contributed the whole of Chapter XVI., and thereby notably enhanced the value of the book, we are especially indebted. Throughout its composition we have also received considerable help from Dr. Mott, Professor Sims Woodhead, Dr. James Miller, and Dr. J. Findlay.

During the passage of the volume through the press we have been greatly assisted by the Rev. Dr. C. T. M'Cready (Dublin), who has kindly read the proofs, and by Mr. William Taylor, to whom we largely owe the compilation of the Glossary.

A special word must be added with regard to the correctness of the illustrations. In a subject like that of the effects of alcohol—regarding which pictorial exaggerations were formerly liable to creep in—accuracy in detail is a matter of great importance. To Miss Kelley our best thanks are due for the fidelity with which she has drawn the specimens, many of which were kindly lent to us by Dr. Mott.

RÉPUBLIQUE FRANÇAISE

LIBERTÉ—ÉGALITÉ—FRATERNITÉ

ADMINISTRATION GÉNÉRALE DE L'ASSISTANCE PUBLIQUE À PARIS

L'ALCOOLISME : SES DANGERS

(Extrait du Procès-verbal de la Séance du Conseil de Surveillance de l'Assistance Publique du 18 Décembre 1902)

(M. le Professeur Debove, Doyen de la Faculté de Médecine,
M. le Docteur Faisans, Médecin de l'Hôtel-Dieu—Rapporteurs).

L'alcoolisme est l'empoisonnement chronique qui résulte de l'usage habituel de l'alcool, alors même que celui-ci ne produirait pas l'ivresse.

C'est une erreur de dire que l'alcool est nécessaire aux ouvriers qui se livrent à des travaux fatigants, qu'il donne du cœur à l'ouvrage ou qu'il répare les forces ; l'excitation artificielle qu'il procure fait bien vite place à la dépression nerveuse et à la faiblesse ; en réalité, l'alcool n'est utile à personne ; il est nuisible pour tout le monde.

L'habitude de boire des eaux-de-vie conduit rapidement à l'alcoolisme ; mais les boissons dites hygiéniques contiennent aussi de l'alcool ; il n'y a qu'une différence de doses : l'homme qui boit chaque jour une quantité immodérée de vin, de cidre ou de bière, devient aussi sûrement alcoolique que celui qui boit de l'eau-de-vie.

Les boissons dites apéritives (absinthe, vermouth, amers), les liqueurs aromatiques (vulnéraire, eau de mélisse ou de menthe, etc.), sont les plus pernicieuses parce qu'elles contiennent, outre l'alcool, des essences qui sont, elles aussi, des poisons violents.

L'habitude de boire entraîne la désaffection de la famille, l'oubli de tous les devoirs sociaux, le dégoût du travail, la misère, le vol et le crime. Elle mène, pour le moins, à l'hôpital ; car l'alcoolisme engendre les maladies les plus variées et les plus meurtrières : les paralysies, la folie, les affections de l'estomac et du foie, l'hydropisie ; il est une des causes les plus fréquentes de la tuberculose.—Enfin, il complique et aggrave toutes les maladies aiguës : une fièvre typhoïde, une pneumonie, un érysipèle, qui seraient bénins chez un homme sobre, tuent rapidement le buveur alcoolique.

Les fautes d'hygiène des parents retombent sur leurs enfants ; s'ils dépassent les premiers mois, ils sont menacés d'idiotie ou d'épilepsie, ou bien encore, ils sont emportés un peu plus tard, par la méningite tuberculeuse ou par la phtisie.

Pour la santé de l'individu, pour l'existence de la famille, pour l'avenir du Pays, l'alcoolisme est un des plus terribles fléaux.

Vu et approvó : *Le Préfet de la Seine*, J. DE SELVES.
Pour copie conforme : *Le Secrétaire Général de l'Administration Générale de l'Assistance Publique*, THILLOY.
Le Directeur de l'Administration Générale de l'Assistance Publique,
G. MESUREUR.

FRENCH REPUBLIC

LIBERTY—EQUALITY—FRATERNITY

GENERAL ADMINISTRATION OF RELIEF OF THE POOR IN PARIS

ALCOHOLISM: ITS DANGERS

EXTRACT from the REPORT of the Sitting of the Committee of Supervision of the Relief of the Poor, December 18, 1902.

Drafted by—

Professor DEBOVE, Dean of the Faculty of Medicine.
Dr. FAISANS, Physician to the Hôtel-Dieu.[1]

Alcoholism is chronic poisoning resulting from the habitual use of alcohol, even when this is not taken in amounts sufficient to produce drunkenness.

It is an error to state that alcohol is necessary for workmen who are engaged in arduous manual labour, that it gives energy for work, or that it renews strength. The artificial excitement which it produces quickly gives place to nervous depression and weakness; in truth, alcohol is useful to nobody; it is harmful to all.

The habit of drinking spirits leads quickly to alcoholism, but the so-called hygienic drinks also contain alcohol; the only difference is one of quantity; the man who daily drinks an immoderate quantity of wine, of cider, or beer, becomes as surely alcoholic as the one who drinks brandy.

The drinks called "aperitives," (absinthe, vermouth, amers), the aromatic liqueurs ("vulnéraire, eau de mélisse or de menthe") are the most pernicious, because they contain—in addition to alcohol—essences, which are themselves also violent poisons.

The habit of drinking leads to neglect of family, to forgetfulness of all social duties, to distaste for work, to want, theft, and crime. It leads, at the very least, to the hospital—for alcoholism causes a great variety of diseases, many of them most deadly: paralysis, insanity, disorders of the stomach and of the liver, dropsy; it is one of the most frequent causes of consumption. Finally, it complicates and renders more serious every acute illness; a typhoid fever, pneumonia, or erysipelas, which would be mild in a sober individual, will rapidly kill the alcoholic.

The hygienic faults of parents are visited upon their children; if the latter survive the first few months of life, they are threatened with idiocy or epilepsy, or, still worse, are a little later on carried off by tuberculous meningitis or consumption.

Alcoholism is one of the most frightful scourges—whether it be regarded from the point of view of the health of the individual, of the existence of the family, or of the future of the country.

Seen and approved by the Prefect of the Seine, J. DE SELVES.

Certified by the General Secretary of the General Administration of the Relief of the Poor, THILLOY.

The Manager of the General Administration of the Relief of the Poor,
G. MESUREUR.

[1] The principal general hospital of Paris.

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INTRODUCTION

Two or three years ago copies of the manifesto which appears at the beginning of this book were placarded officially in various parts of Paris. The "posters"—printed in large black print (the sign of their being issued with Government authority)—were affixed to the walls of the waiting-rooms and corridors of hospitals; they were put up in the post-offices and streets of that great city, and upon the outside wall of the Hotel de Ville (Municipal Buildings) itself.[1]

Now it must be observed that it was not by teetotallers that this was done, but by men in the highest public positions in Paris, *i.e.* the Director and Secretary of the Poor Law Administration, the Dean of the Medical Faculty of Paris, and others—men whose work as guardians of the public health brought them face to face with the great problem of how to make France a vigorous and effective nation.

Some of us hardly comprehend what the thought

[1] In France only the State officials are allowed to issue "posters" in black type on white ground. (The speeches of Cabinet Ministers are often ordered to be placarded thus all over the country.) This being the official method, all placards and posters in this type carry with them an authority which ensures their being read carefully.

of "La France" means to an earnest Frenchman. Suffice it to say that anything that indicates weakness in the national physique is to him a matter of serious import, leading him to make efforts (such as the issuing of the placard in question) to increase the physical fitness of his compatriots, so that his country may run no risk of losing its high rank amongst the nations of the world.

The end of the story, alas, possesses elements of human frailty and selfishness. The vendors of alcohol in Paris rose up in indignant protest, declaring that the manifesto was calculated to injure their trade. It was removed from many places, but it was left in certain hospitals and on the wall of the Hotel de Ville, where we saw it in June 1903. Upon application at the Office of Public Health we were given copies, with a caution not to placard them over England!—the officials hinting, with a smile, not that the facts were at fault, but that the "Trade" in England might make trouble, as it had done in Paris!

It is worthy of note that in France the medical profession has been striving for some time to arouse public anxiety on this matter of the danger of alcohol, a danger which that country as a whole is now beginning to realise.

In England a concurrent advance of medical knowledge and thought has lately been taking place, which has been due to, and kept pace with, the steady flood of scientific light that of recent years has been thrown

upon the subject of the action of alcohol upon the human body, a light which has elucidated facts both new and unexpected. As these various important facts have been discovered, fresh zeal has been inspired and fresh investigations set on foot — new methods and new instruments being constantly devised in order that the investigations might be more effectively carried on. Such earnestness is one sign of the widespread enthusiasm for scientific research which has swept over Europe during the last forty years, transforming both our understanding of whole provinces of natural phenomena and also our methods of dealing with them.

Particularly in regard to the alcohol question, this increase of information and consequent growth of scientific opinion have been most striking. Until recently there has been relatively little accurate, *i.e.* experimental, knowledge upon the subject, and the popular belief that the effect of alcohol was beneficially soothing and stimulating has been accepted without criticism. As an excitant, always ready to hand, it was concluded—this being a matter of pure assumption—that it was a drug of permanent value as a stimulant, and one which any person might use at his own discretion.

Herein lay not only an assumption, but a profound error, the rectification of which has been reserved for the scientific workers of the present day, with more accurate methods of observation and more delicate apparatus of greater exactitude and precision. For

instance, the improvement of the microscope and of histological methods has rendered possible the discovery of changes in organs and cells which fifty years ago were undreamed of; and such discoveries alone are fast altering the whole aspect of the alcohol question.

The interest of men of science in the subject, although at its origin purely abstract, has in some cases developed into a patriotic desire to discover the actual facts about a liquid so largely consumed by mankind, and which, therefore, must inevitably rank as an important factor in the national welfare either for good or evil.[1] Indeed their discoveries have not infrequently had the unexpected effect of making them advocates of temperance reform. For instance, Professor Kraepelin of Munich states that as a result of his prolonged investigations[2] into the effects of very small quantities of alcohol on the nervous system and the mind he has become "an opponent of alcohol."

Some of the results of this research work we propose to lay briefly before our readers, purposely giving, in the more obscure and complicated parts of the subject, the *general conclusions* arrived at by

[1] In Belgium, the State, realising the great evils wrought by the drinking of spirits, has recently forbidden its sale at all railway stations. This is practicable, because the railways all belong to the State.

"The official *index* of the literature of the alcohol question in Switzerland (including the practical and social questions as well as the scientific investigations) contains 172 pages."—HELLENIUS.

[2] Made chiefly at Heidelberg.

competent observers rather than detailed proofs, which would require far more space than is at our disposal in this volume. For the same reason, in several chapters we have touched upon the elements of physiology with extreme brevity; in others we have omitted them entirely. We may refer the student to one or more small and excellent books for wider study of this part of the subject.[1]

Looked at from a purely scientific standpoint, the question of the effect of alcohol is one of fact alone, and not even the tragedies and the poverty which result from its habitual use can prejudice its consideration. Therefore, though all scientific subjects have a grave socio-political and national importance, and none more markedly so than that of alcohol, we propose in this little volume to put forward the present state of knowledge of alcohol solely on the basis of experimental, anatomical, and statistical evidence.

[1] As, for instance, Hill's *Elementary Physiology* (price 1s. 3d., post free), or *Elementary Physiology*, by Ernest Starling, M.D. Lond. (price 1s.), or any other small manual in which the elements of physiology are explained.

ALCOHOL A DRUG

"The baneful effects of the poison affect all communities."
—VON ZIEMSSEN.

"Alcohol is a poison—so is strychnine; so is arsenic; so is opium. It ranks with these agents. Health is always in some way or other injured by it."—The late Sir ANDREW CLARK, M.D., Physician to H.M. Queen Victoria.

"Through the accumulation of small injuries it is that constitutions are commonly undermined, and break down long before their time. And if we call to mind how far the average duration of life falls below the possible duration, we see how immense is the loss."—HERBERT SPENCER, *Education*, p. 14.

"The old saying, 'Wine is the milk of old people,' is entirely wrong; that, on the contrary, milk is for old people, with rare exceptions, one of the best articles of food; while the habitual use of alcohol, excepting in the smallest quantity, is to them even more injurious than to younger people in their full activity."—Sir HERMANN WEBER, M.D., F.R.C.P., 1906, author of *The Prolongation of Life*.

CHAPTER I

ALCOHOL A DRUG

Alcohol is a drug which, among others, is used by many nations as a beverage or as a medicine, very often without the least discrimination. And yet as a drug its effects are most marked, and therefore skilled knowledge is required in its use.

Complexity of Drug Action

Only those who make a life's study of the action of drugs have any conception of the great complexity of the subject of their administration. In spite of this it is common enough to hear a patient inquire: "What is the action of such and such a substance?" as if he thought the answer could be conveyed to him in a short sentence. Now the full reply to such a question is almost invariably difficult and intricate—for, although most drugs have a more or less selective effect, any single one probably exerts half-a-dozen actions on a similar number of the various tissues of the body, actions which a skilful physician requires to think out carefully, and balance fully, one against

the other, before finally deciding on its use in a given case. Alcohol is a drug which is no exception to this rule, inasmuch as it has a very widespread influence on the different parts of the human frame, and consequently requires prescribing with as much care as any other remedy in the Pharmacopœia.

Scientific Evidence causes Change in Medical Treatment

The scientific evidence now at the command of the medical profession regarding the action of alcohol may be divided into two groups :—

(1) Evidence indicating that alcohol does not aid the human economy in the way popularly supposed.

(2) Evidence proving the occurrence of actual damage to the structure and functions of the different organs.

Both classes of evidence have for some time been carefully studied and weighed by the profession, and as a result on all sides indications may be seen that the real position which alcohol holds among narcotic drugs is becoming better known. Moreover, the gradual and recent discovery of several valuable and reliable medicines renders frequent resort to the use of alcohol as needless as it is often unsatisfactory, and, as a matter of fact, its rôle is becoming more and more restricted.

The reason for this marked alteration in medical as well as surgical treatment is twofold. In the first

place, modern physicians and surgeons are cautious in prescribing alcohol, now that its double-edged action and many reasons for its disuse therapeutically, have been proven; and, in the second place, as guardians of the public health they desire to limit and safeguard even the medical employment of a drug concerning which they have daily evidence that its social or customary use is undermining the happiness and welfare of large numbers of the community.

The general trend of medical opinion upon this matter is shown in a striking way by the steady fall in the amount of alcohol used in hospitals during the last forty years.

In 1883 Charles J. Hare, M.D., F.R.C.P., published an analysis of the money expended by a number of the leading London Hospitals, during one year in each decade between the years 1832-82, upon alcohol and milk respectively; and, owing to the great courtesy of the Secretaries of these same institutions, we have been able to carry some of these statistics up to date. Taking those hospitals[1] from which the returns are complete for the last forty years (1862-1902), we find that the figures stand as follows :—

[1] Names of Hospitals from which the table is composed :—St. Bartholomew's, Guy's, Middlesex, St. George's, St. Mary's, University College, Westminster.

For the expenditure on alcohol in the individual hospitals, see *Burdett's Annual Report.*

[Table.

Table showing Total Number of Beds in the Seven Hospitals together with their Total Expenditure on Alcohol and Milk for each Year indicated.

(The totals as to expenditure include both "Staff" and "Patients.")

Year.	Beds occupied by Patients.	Expenditure on Alcoholic Liquids.	Expenditure on Milk.
1852	...	...	...
1862	2254	£7712	£3026
1872	2361	7974	4237
1882	2354	5090	7795
1892	2275	3740	7362
1902	2309	2925	9035

The facts are represented graphically upon the accompanying chart, which shows that alcohol and milk have practically changed places as regards the extensiveness of their use. (Plate I.)

The following statistics of the expenditure on alcohol and milk in Salisbury Infirmary for the years 1865 to 1905 are useful as substantiating our statement as to the increasing disuse of alcohol in medical treatment. The figures are taken from the annual report of the Salisbury Infirmary :—

Year.	Wine and Spirits.	Beer and Porter.	Total.	Milk.
1865	£164	£138	£302	£94
1870	156	154	310	130
1875	136	114	250	158
1880	122	95	217	219
1885	79	63	142	272
1890	93	52	145	235
1895	72	42	114	378
1896	52	46	98	335

PLATE I.

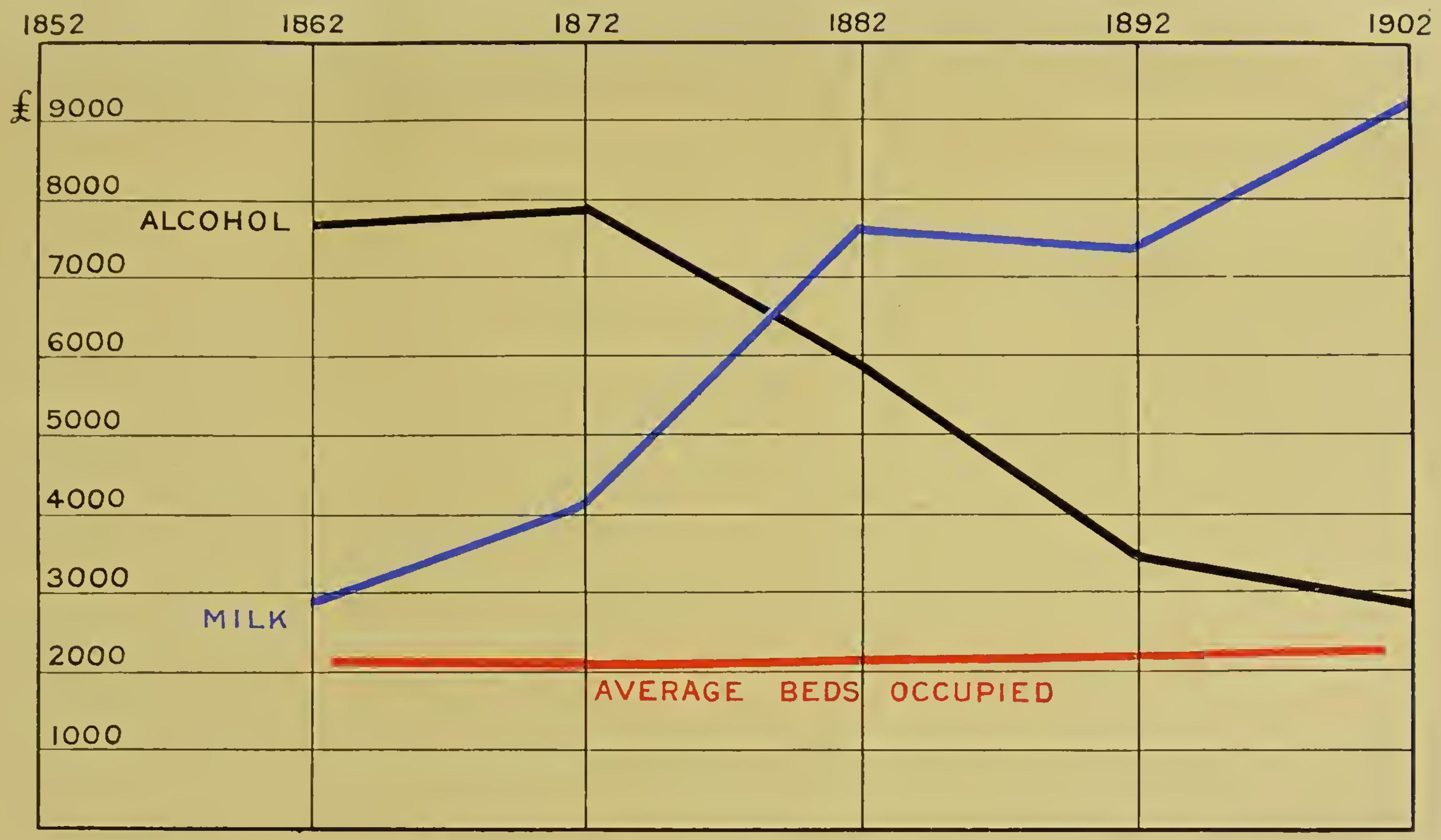

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Diagram in continuation of Dr. Hare's Table showing the gradual diminution during the past forty years in the administration of Alcohol and the increase in the use of Milk during the same period. The figures are summarised from the statistics of seven large London Hospitals.

To face p. 6.

ANNUAL REPORT OF SALISBURY INFIRMARY—*continued.*

Year.	Wine and Spirits.	Beer and Porter.	Total.	Milk.
1897	£69	£40	£109	£304
1898	41	53	94	301
1899	34	40	74	311
1900	38	26	64	321
1901	29	21	50	318
1902	29	22	51	327
1903	42	27	69	370
1904	19	19	38	354
1905	11	7	18	317

Equally striking are the figures of the Infirmary of the Wandsworth Union, London :—

Year.	Number of Patients under Treatment.	Cost of Wine and Spirits.	Cost of Milk.
1875	1405	£371 0 0	£407
1885	2419	53 0 0	577
1895	3559	3 19 2	1143
1905	5451	2 7 5	1226

Although the number of beds in the above-mentioned seven London Hospitals happens to have but slightly increased, the actual number of patients treated each year is much larger, because since the introduction of aseptic surgery the recovery after operations is far more rapid than formerly, and beds are therefore vacated more quickly.

Disuse of Alcohol in Surgery

The introduction by Lord Lister of his inestimable boon to humanity, antiseptic surgery, swept

away—with the septic diseases, blood poisonings, gangrenes, etc.—any necessity for the treatment of operation cases with alcohol. In fact, the only surgical condition in which alcohol is still thought by some to be of use is "shock," and even in this respect it is now giving place to other and more scientifically administered measures.

Some of the present-day rapid recoveries are also due to the fact that after operation the patients are no longer dosed with alcohol under the mistaken idea that it hastens recovery, and possibly also to the fact that they are increasingly encouraged to abstain from alcohol before the surgeon operates. Consequently, apart from the greater question of antiseptic improvements, the processes of repair and of healing proceed more quickly than in former times.

The change is of course obvious, in both the medical and surgical aspects of treatment.[1]

Disuse of Alcohol in Medical Cases

To what an extent this has now reached, one example, viz. that of the treatment of "Fever," will suffice to show. We are much indebted to the Clerk and Medical Superintendents of the Metropolitan Asylums Board for most courteously providing us with the following statistics on this point :—

[1] See particularly the Presidential Address by Dr. Handcock, President Bradford Medical Chirurgical Society, Oct. 17, 1905, "On the Demerits of Alcohol as a Therapeutic Agent," *The Medical Temperance Review*, Dec. 1905.

Metropolitan Asylums Board

Return of Patients treated in, and of Cost of Alcohol consumed in, the Board Hospitals

Year.	Total under Treatment.	Cost of Stimulants consumed.
1894	19,937	£1388
1895	19,360	1579
1896	25,773	1653
1897	27,435	1279
1898	25,725	1149
1899	29,469	1332
1900	26,549	1555
1901	29,810	1248
1902	29,139	1138
1903	21,925	770
1904	21,184	529
1905	27,162	515

(See Fig. 1.)

The immediate deduction from these figures is, that whereas up to ten years ago alcohol was extensively used in the treatment of fevers, it is now recognised that the disadvantages attendant on its employment often outweigh any prospective advantage to be obtained from its routine application. Even in the treatment of enteric fever its supposed value is undergoing searching criticism, as instanced by the following words of Dr. Ford Caiger, Medical Superintendent of the South-Western Fever Hospital, M.A.B.:—

"I rank myself with those who hold that in most cases

of enteric fever not only is alcohol not required, but that its employment is occasionally distinctly harmful, even when given in quantities which would not be considered excessive."[1]

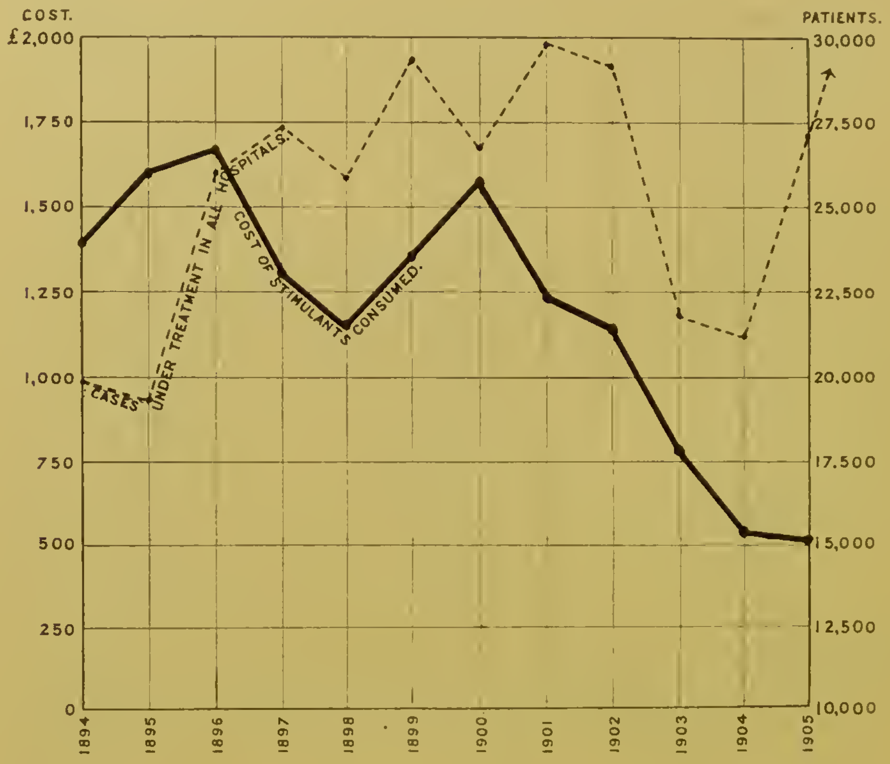


FIG. 1.—Metropolitan Asylums Board Statistics. Diagram showing the fall in the administration of alcohol to fever patients during the years 1894 to 1905. The dotted line shows the number of patients beginning in 1894 with 20,000. The continuous black line shows the amount of money expended on alcohol, beginning in 1894 with £1388, and falling to £515 in 1905, although the number of patients in the hospitals that year was 27,162.

Disuse of Alcohol in the Treatment of Insanity

The office of the Asylums Committee of the County of London has placed at our disposal the following

[1] Bradshaw Lecture on "The Treatment of Enteric Fever," *Brit. Med. Journ.* Nov. 26, 1904.

PLATE II.

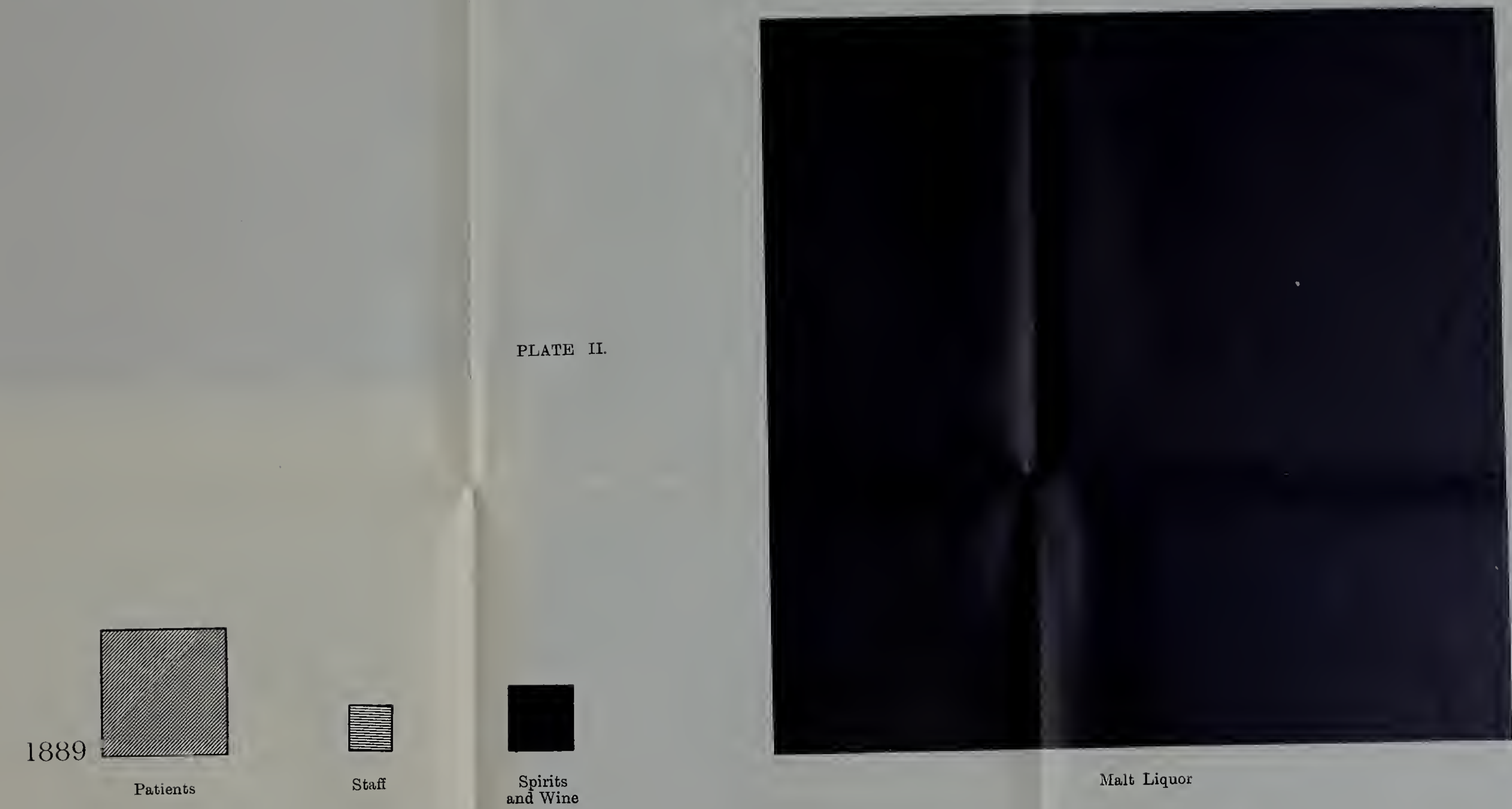
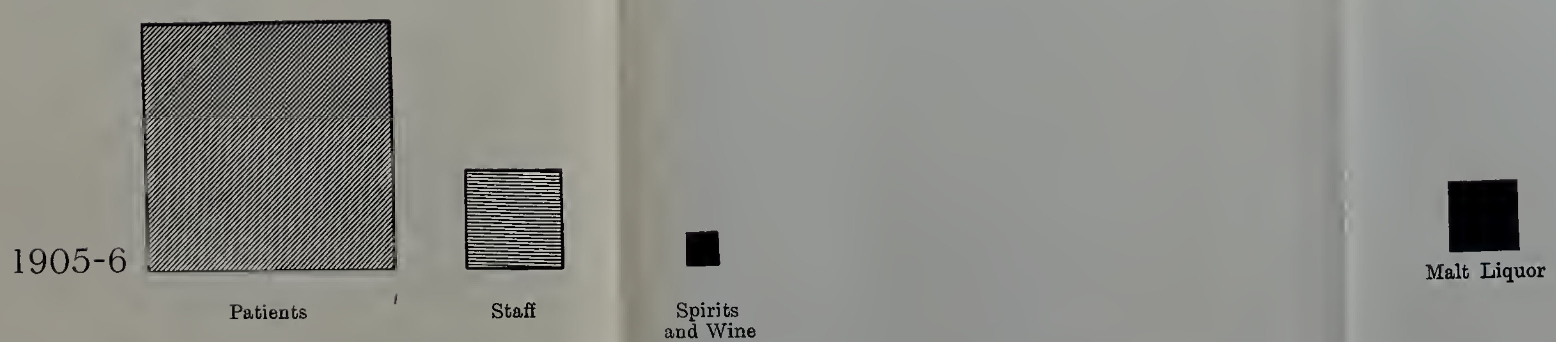


Diagram showing consumption of alcoholic liquors by 8,107 Patients and Staff in 1889.



Similar diagram for the year 1905—showing increase in Patients and Staff and decrease in use of alcoholic liquors.

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valuable facts, which show the complete revolution that has taken place during the last twenty years as regards the use of alcohol in the treatment of insanity. This, of course, was practically inevitable as soon as the true scientific effect of this drug upon the nervous system had been worked out and was understood in the medical world.

London County Asylums

Comparative Consumption of Spirits, Wine, and Malt Liquor, 1889 *and* 1905-1906

	1889.	1905-1906.
Number of Asylums open .	Four	Nine
Persons boarded—Patients .	7,246	17,024
Staff .	861	2,433
Total .	8,107	19,457
	Pints.	Pints.
Spirits consumed . .	8,529	1,741
Wine ,, . .	6,687	265
Total Spirits and Wine consumed.	15,216 = 1,902 gallons	2,006 = 250 gallons
	Gallons.	Gallons.
Beer consumed . . .	255,486½	1,281½

Thus, although during the last sixteen years the number of patients taken over by the London County Asylums has more than doubled, the total amount of

spirits and wine consumed has dropped from 15,000 to 2000 pints, and the amount of beer has fallen from 255,000 to 1000 gallons per annum. This change is shown diagrammatically in Plate II.

Place of Alcohol in Pharmacology

Alcohol belongs to the class of medicines known as narcotics, the class which also includes chloroform and ether—drugs which have a twofold action, being: (1) temporarily exhilarant, for a short time; (2) depressant, for a much longer time. The temporary stage of exhilaration is followed, more or less rapidly according to the amount taken, by a stage of sleepiness or actual insensibility which lasts longer than the stage of excitement.

For instance, if only a small quantity of ether or chloroform be inhaled, there is a pleasant feeling of warmth and sensation of vigour,[1] followed later by drowsiness and a desire to sleep.

In patients who are given these drugs in larger quantity, there is a short stage of exhilaration, garrulity, and loss of complete mental control, followed by the lowering of bodily temperature and a stage of deep sleep and loss of power to move or feel. Alcohol acts in precisely the same way. Its anæsthetic action (in vapour) was, in fact, made use of in 1839, in which year Dr. Collier performed a

[1] This subjective sensation of increased vigour is, of course, delusive.

surgical operation on a negro who was rendered insensible by breathing the fumes of alcohol. This was the first published case in which an anæsthetic was used. Ether and chloroform were discovered later.

Alcohol a Poison

Drugs are usually classified according to a quasi-scientific estimate of the degree of poisonous activity they exhibit when introduced into the body. It is interesting to note that alcohol is always included among the "poisons," and in the pharmacological classification of "poisons" it is invariably placed side by side with chloroform and ether and described as a narcotic poison. This is the position assigned to alcohol by the pharmacologists of all countries.

For instance, the celebrated physician and clinician, von Ziemssen, describes the action of alcohol in the following words:—

> "The outward symptoms are like those induced by other narcotics. . . . The nerve centres have their function stimulated at first . . . then their activity is gradually abolished for the time . . . modified by the quantity of the poison taken, and by the time the poison is working—so that we see a variety of phenomena—sometimes only the stage of excitement, sometimes the paralytic. . . . The baneful effects of the poison affect all communities."

Without doubt it is scientifically correct to speak of alcohol as a poison, but as this statement has been questioned in the past, we cannot close this paragraph

better than by quoting the following forcible sentence from the physiologist, Professor Fick :—

"It is a daily occurrence to find persons unaccustomed to the use of alcoholic liquors after drinking a small glass of wine (3 oz.) complain of dizziness, etc., indicating a circulatory disturbance. During these few moments it is hardly possible that more than one-third of the teaspoonful and a half of alcohol contained in the three ounces of wine could be absorbed and find its way into the blood. The amount of alcohol in the blood is thus less than one-half volume in a thousand, as the total amount of blood in the body is equal to about five quarts: and yet this almost inappreciable amount of alcohol in the blood causes a very decided disturbance in the action of the nervous system. Hence, there is no reason for being in doubt as to the justice of calling this substance a poison."

Cumulative Action

Like the other members of its class, alcohol has a cumulative action. Moreover, it is also to be borne in mind that the residual consequences or effects of even small quantities habitually taken, accumulate, and, as will be more fully discussed, gradually affect the efficiency and well-being of the individual.

The immediate action of any given drug is liable to vary somewhat in intensity according to the varying circumstances and conditions of the body into which it is introduced, and we must now devote a brief space to the discussion of this subject.

Conditions which modify the Action of a Drug such as Alcohol

Pharmacologists, whose duty it is to study the actions of drugs, have found that such actions are modified in many ways, *e.g.* by:

(1) Age.

(2) Muscular exercise.

(3) Personal idiosyncrasy: craving for "repetition," etc.

(4) Habit.

We will study these conditions separately.

1. Age

In the matter of age it is, in the first place, needless to point out at length how especially injurious alcohol is to the growing structures of young children. This is universally recognised. We shall later on devote a chapter (Chap. XIV.) to the question of the direct action of the drug on young tissues generally, and, therefore, shall only now discuss the statement that there is no age of life in which alcohol can be unconditionally said to be actively useful.

For instance, the popular idea that alcohol is of benefit in old age is far from being true. By leading to delayed excretion (see Chap. XIII.), and by gradually weakening the circulation (see Chap. XII.), it frequently causes a lowering of vitality, even when only given in small doses.

"Wine is not, as is supposed, 'the milk of the aged'; it

tends to produce cardiac weakness, muscular and rheumatoid pains, and deterioration of the fine arterioles and blood-vessels. Alcohol is also responsible for much insanity and mental disorder."[1]

At first alcohol often acts in the aged as a narcotic, and because it assists thus in inducing sleep, it is often regarded, not unnaturally, as a useful drug—but, as a matter of fact, it at the same time increases the senile decay. Nothing is more striking than the marked improvement seen in cases of acute mental depression in elderly people, when the giving of alcohol is stopped and the eliminative powers of the patient are aided by medical treatment.

2. Exercise

The amount of exercise taken markedly affects the elimination of any poison, such as alcohol. A man walking about all day in the fresh air of the country excretes effectively, and is able, therefore, to get rid of the drug out of his system faster than a man who lives in a town. This is one of the reasons why the inhabitants of towns succumb more quickly to the action of alcohol than do those who live in the country.

3. Personal Idiosyncrasy

Personal idiosyncrasy with regard to drugs is a factor which, though very difficult to estimate

[1] Sir Thomas Barlow, M.D., K.C.V.O., *British Medical Journal*, April 1, 1905.

accurately, is always present. In the case of alcohol, there are in our midst far more people than is generally realised who are "very susceptible"; persons, namely, in whom quite a small dose will produce marked symptoms of deterioration, and even occasionally intoxication. This is especially the case when there is any hereditary alcoholic taint, or where there is any family tendency to insanity or organic disease of the nervous system. Many such persons are adversely influenced by a dose that does not to ordinary observation affect others.

Moreover, there are always considerable differences in normal human beings as to the way in which they tolerate drugs, and this is especially true of alcohol. For instance, patients who have suffered from head injuries or from sunstroke frequently find that they cannot take the smallest dose of alcohol without being upset. In other words, the natural sensitiveness of the body to the action of this powerful drug is notably increased in such cases. It is easy to understand, in these instances in which the circulation has already been affected by an accident to the head, that the alcohol probably acts by causing rapid flushing, *i.e.* physiological congestion by dilating the blood-vessels of the brain (see Chap. VII.); but there are, in addition, many persons in the community who have inherited an unstable nervous system and who have a lessened tolerance for alcohol, in whom the susceptibility is probably due to the abnormal state of their nerve-cells and tissues generally.

Apparent Toleration shown by some Persons to Alcohol

Frequent attempts have been made to ascertain whether there exists a minimum dose of alcohol which a man can take without being affected in any disadvantageous way—and, in accordance with the steady advance of scientific opinion on this matter, smaller and smaller amounts have been suggested as permissible. In reality we have no proof that a minimum and permissible dose exists at all.

The fact that certain men seem able to assimilate alcohol without obvious evil effect, simply means that they happen to be strong and stable in health, and so are able to withstand, without immediate signs of injury, the effect of doses which are disastrous to many highly strung, sensitive persons. After a military campaign there are always some men who return alive and not apparently injured; but this does not alter the fact that a large proportion of the soldiers are either killed, disabled, or overstrained by the war.

Indeed, this apparent toleration of alcohol is, in the majority of cases, only a deception; for, when illness comes to a man of this type, it is found that his tissues show signs of being unduly disposed to inflammatory conditions, and that invading microbes and germs create undue havoc in spite of his naturally strong body and originally good endowments in the way of health. Moreover, the real condition of an apparently very strong and robust

man who habitually takes large quantities of alcohol will be often demonstrated by the decadence of his children and grandchildren, who are frequently epileptic, mentally defective or vicious, and of impaired vitality.

One conclusion emerges from the recent investigation of the whole alcohol question, namely, that it is quite impossible to state that any given minimal amount of the drug is harmless to our tissues. A man who desires to use his entire force on behalf of himself or his fellow-men can do so best and longest by entirely avoiding alcohol.

Drugs that induce a Craving for Repetition

A point always to be remembered in the giving of any medicine is, that not a few drugs have a curious tendency to induce a craving for their repetition.

This being so, we need hardly say that a careful physician exercises the greatest thought before prescribing any medicine of this character. Unfortunately, although alcohol is one of these drugs, and creates in many of those who take it a strong craving, its use by the public generally is so common that it is not regarded as it should be, viz. as always a possible danger. We shall consider this perilously Utopian view of alcohol more fully in Chapter IX.

It is very instructive to note that alcohol behaves in the same manner as morphia when it is taken for the first time. Thus at first it is often vomited. The exquisitely delicate lining

of the stomach, as we shall see later on, is irritated, and the stomach proceeds to eject the irritant. Subsequently, however, a tolerance is established, and the body becomes accustomed to the intruder, and even feels its withdrawal. We are such "creatures of habit" that we readily become accustomed to any routine, and a few weeks ("six" according to the psychologist, Professor William James) afford sufficient time wherein to form the foundation of a deeply rooted habit. Unfortunately, in the case of alcohol its withdrawal usually means that a "craving" follows, and this is a condition to be dreaded, unless we are possessed of a very strong power of self-control. Dr. Clouston, Medical Superintendent of the large Morningside Lunatic Asylum, near Edinburgh, has well said that "it always implies less expenditure of energy to crave than to control." In this trite sentence lies the gist of much of the trouble with regard to alcohol and the drug habit in general. He points out that very many people entirely lack this high faculty of "control." To "crave" is easy, to "control" is difficult; therefore, the wiser course is to avoid those things which tend to create a craving.

"The moment we have a craving for something that, if attained, would be hurtful to the organism, then we have something that is contrary to Nature's law, and is more or less of the nature of disease. It is one most prominent characteristic of our modern civilisation, that it exerts itself to create 'artificial' needs in all directions, physical and

mental, and each one of those enlarges the area of human desire. Such needs and desires soon become hereditary. *We feel them because our fathers created them.*"[1]

4. Habit

The effect of habit upon ourselves, and its hereditary influence upon our children, are matters that no person of thought and intelligence can ignore. When taken as a daily drink, alcohol causes sensations and effects which are soon imagined to be a necessary part of life. The stomach becomes dependent on the daily dose and disinclined to work without it. When this physiological dependence occurs it is time to recognise both the true facts of the case, and our bondage to the habit, rather than falsely to regard alcohol as a "food," because it induces certain sensations to which we have become accustomed.

It is, indeed, not a matter of mere personal import but of national concern that we should reckon with this factor of "habit" before encouraging ourselves or others to do or take what may prove to be injurious both to the individual and to the future generations of our race.

After this preliminary view of the special nature of alcohol as a drug, we propose in the succeeding chapters to show how this substance acts upon the various tissues and systems of the body, prefacing the

[1] Dr. Clouston.

discussion of these effects with a chapter on what alcohol is from a chemical point of view, and concluding with a chapter kindly contributed by Dr. Newsholme, showing the gross social and vital effects it produces on communities or groups of individuals.

THE CHEMISTRY OF ALCOHOL AND OF ALCOHOLIC BEVERAGES

"Beer is a far more dangerous enemy to Germany than all the armies of France."—VON MOLTKE.

"Alcohol is a waste-product in the activity of the yeast plant."[1]—C. F. HODGE, Ph.D., Professor of Physiology, Clark University.

[1] *Physiological Aspects of the Liquor Problem.*

CHAPTER II

THE CHEMISTRY OF ALCOHOL AND OF ALCOHOLIC BEVERAGES

When in everyday life we talk of alcohol, we think either of one particular substance, or more often, perhaps, of the drinks or beverages of which the most conspicuous property—that of causing intoxication—is too well known. All these beverages possess one point in common, namely, that of containing more or less of a powerful chemical substance named alcohol, or, more properly, "ethyl alcohol." For instance, beer is a drink containing about 5 parts of alcohol in every 100 parts of beer, *i.e.* 5 per cent. The composition of beer is, roughly, as follows:—

Water	83·1	per cent.
Albumin	0·6	,,
Sugar	1·8	,,
Mineral	0·4	,,
Extractive	8·2	,,
Alcohol	5·9	,,
	100	

The different alcoholic beverages may be classified into three groups: (1) beers; (2) wines; (3) spirits or distilled liquors.

1. **Beers.**—The principal beverages belonging to this class are porter, stout, and various beers, such as lager beer,—with a percentage of alcohol of 4 to 7 per cent.

2. **Wines.**—Belonging to the second class we have port wine, sherry, claret, champagne, and home-made wines. In ordinary wine the amount of alcohol is somewhat greater than the amount in beer,—varying from 9 to 22 per cent. In home-made wines, such as "currant," "raspberry," "elderberry," "cranberry," "orange," "gooseberry," or "rhubarb" wine, between 5 and 12 per cent of alcohol is found.

3. **Spirits.**—The liquids of the third class—brandy, whisky, and other spirits—contain 40 to 56 per cent of strong alcohol.

The amount of alcohol contained in certain well-known alcoholic beverages is as follows:—

	Percentage of Alcohol.	
Beer	4 to 5	per cent.
Cider, Perry, and other home-made wines	5 to 10	"
Hock, Claret	8 to 11	"
Port, Marsala	9 to 22	"
Orange Wine, Raspberry Wine . .	10 to 12	"
Champagne	10 to 15	"
Sherry, Madeira	14 to 17	"
Rum, Gin, Strong Liqueurs . .	40 to 50	"
Whisky	44 to 50	"

	Percentage of Alcohol.
Brandy	48 to 56 per cent.
Rectified Spirit	84 per cent (by volume).
Methylated Spirit[1]	90 per cent (by volume).

It must be clearly understood that, in all the beverages above mentioned, alcohol is present—the amount being only a matter of proportion. In a pint of ale there are two tablespoonfuls of alcohol: while in a pint of wine there are about six tablespoonfuls, and a pint of brandy consists of about equal parts of alcohol and water.

Preparation of Alcohol

Alcohol may be prepared in a number of ways, but all that we need remember for practical purposes is that it is obtained as a rule from the fermentation of sugars. Starchy materials are also used, these starchy materials being utilised in order to provide the sugar needed for fermentation.

Fermentation

Fermentation is a common process with which we are familiar in everyday life. It is the process by

[1] *Methylated Spirit*, which is largely used for burning in spirit lamps, and in the preparation of different kinds of wood-polish, consists of about 90 per cent of ethyl alcohol and 10 per cent crude wood spirit (impure methyl alcohol), together with a small quantity of naphtha added for the purposes of rendering the spirit undrinkable.

which milk becomes sour, butter turns rancid, fruit decomposes, and beer is formed from malt. In all these cases a chemical change takes place, and we have to consider how this change is caused. When milk is left standing exposed to the air, it turns sour without anything apparently being added. But the air is full of minute forms of vegetable life—"micro-organisms"—which, although so small that they can only be seen with a powerful microscope, are extremely active. They produce something which is called a ferment or "enzyme," and it is due to this ferment that the chemical change called fermentation takes place. Therefore, in order to prevent milk or various other substances from fermenting, it must be kept away from the air or anything containing these micro-organisms.

The fermentation by which alcohol is produced is chiefly brought about by an air-borne micro-organism called the yeast plant, growing in the presence of sugars, as will be explained later on. This yeast plant produces a ferment which acts especially on certain sorts of sugar, splitting them up into alcohol and carbon dioxide (carbonic acid) gas. Fermentable sugars, *i.e.* sugars capable of being thus split up, are found in many situations and many substances, for instance, in grapes, in apples, and in barley-grains at a certain period of their growth.

In the case of grapes the micro-organisms which produce the right kind of ferment to turn the grape sugar into alcohol, gather from the air and collect

upon the outside of the grape. While there, they cannot attack the juice,—but as soon as the grapes are crushed and squeezed into a pulp and the skins are broken, the micro-organisms begin to grow and increase very rapidly, at the same time producing their ferment, which splits up the sugar in the grapes into alcohol and carbon dioxide gas, bubbles of which escape freely.

We have mentioned the sugar which exists in grapes; and we must now describe another kind of sugar which is found in sprouting barley, and can also be turned into alcohol, provided that there be present the ferment which is produced by the micro-organism called yeast.

Description of Yeast

Yeast is a microscopical plant, consisting of a single cell. It grows and multiplies very rapidly by budding when placed in a warm sugary solution such as "sweet-wort," and ferments the sugar, breaking it up into alcohol, water, and carbonic acid. But, strange to say, there is a definite limit to the growth and multiplication of

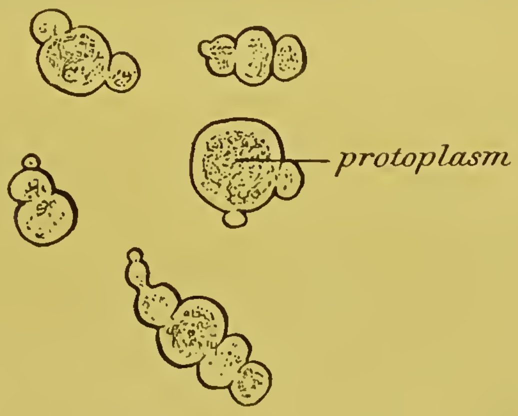

FIG. 2.—Yeast cells in active growth and budding. The protoplasmic centre of each segment is shown as a granular material.

the yeast plant, for alcohol of a certain strength hinders its activity. When first placed in the sugary solution the yeast thrives vigorously; bubbles of carbonic acid (carbon dioxide) gas rise to the surface and alcohol collects in the vat. Gradually it shows less sign of vigour, and finally, when the alcohol present in the solution reaches 13 per cent, the growth and multiplication of the yeast ceases, being checked and finally arrested by the presence of alcohol in the surrounding fluid. Thus the alcohol is not a source of either energy or food to the yeast plant, but on the contrary is injurious to it and stops its growth. This remarkable fact is in accordance with recent "findings" of science as to the inhibiting effect of alcohol upon plant growth, to which we shall refer in the next chapter.

Sources of Sugar used in the Manufacture of Alcohol

The most interesting part of the processes involved in the preparation of alcohol is undoubtedly the method adopted in order to obtain large supplies of cheap sugary liquids in which yeast has the power of growing and therefore of converting them into alcohol.

Fortunately for the brewer there is provided in nature a store of such sugar, which is meant to supply growing seeds with nourishment, during the period of growth which occurs before their rootlets are developed and are able to obtain their food from the soil. A grain of barley in the dry state consists largely of insoluble starch lying in contact with the

tiny embryo plant. Now, as soon as the grain becomes moist and warm and ready to sprout or germinate, this stored-up starch begins to alter (under the action of an agent present in many plants known as "diastase") into a soluble form of sugar. This is needed as the food-supply for the germinating plant, and if undisturbed the little barley germ thrives for some time on this sugar, until it is vigorous enough to send out rootlets into the soil and thus become an independent plant capable of growth and development.

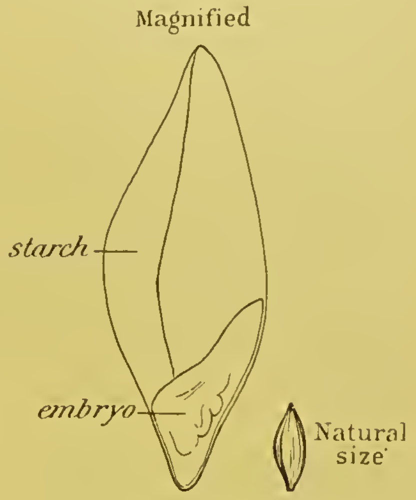

FIG. 3.—Two drawings of a barley corn. The small one on the right shows the grain of its natural size. The large drawing is the same grain magnified to show that it mainly consists of starch by the fermentation of which sugar and alcohol are produced.

Now the first part of the art of brewing consists in starting this process of germination; then in waiting a few days until the grain has developed its diastase and part of the conversion of starch into sugar has occurred; and then in suddenly checking the process of development by over-heating the growing grains in a kiln, thereby arresting their growth so that they shall not use up the sugar. This is known as "malting."

The next process consists in grinding and breaking up these sprouting grains of malt, so that all the rest

of the starch can be acted on by the diastase, which is so powerful that it is able to convert into sugar a certain amount of further additional starch if this be added to the solution. The resultant liquid is called "sweet-wort," and from this the tiny plants are now separated. After being dried and packed they are used as food for cattle.

When yeast is added to the sweet-wort, the soluble sugar it contains is rapidly converted into alcohol, carbonic acid gas, and water, as already explained on p. 29.

Finally, the liquid containing the alcohol and water is put through various processes. Sometimes it is heated and the alcohol driven off with a view to its separation and the preparation of "spirit." On the other hand, if beer is required, certain other preliminary processes are carried out,—for example, such things as "hop bitters," or its substitutes, are mixed with the "sweet-wort" before fermentation is set up. If ale is being prepared, substances giving more "body" to the alcoholic solution are added.

The practical details as to the manufacture of these beverages are very many, and would be out of place here; the one point of general interest being the simple fact that beer is prepared from the fermentation of malt grain, but also in very large quantity from other less desirable substances, and that to this solution other materials, for various reasons, are frequently added. The exact nature of these and the chemical processes through which they

are passed are secrets known to the trade—but it is notorious that in the manufacture of beer as carried on to-day in England, malt substitutes, hop substitutes, and various chemicals for preserving the beer are frequently used.

In the House of Commons, May 23, 1905, the Chancellor of the Exchequer reported, as a result of the Inland Revenue Analysis during the preceding two years, that in eighty cases objection was raised by the Government to the articles used as brewing materials on some one of the following grounds :—

(1) That the samples examined showed the presence of arsenic beyond the limit recommended by the Royal Commission on Arsenical Poisoning; (2) the presence of copper; (3) the presence of quillaia bark or extract; or (4) that there were alcoholic flavouring essences.

The evidence given before the Departmental Committee on Beer Materials (1899) is indisputable, and may be here quoted.[1]

Materials referred to by previous Witnesses as used by Brewers

(Separated into Groups.)

Malt and its Substitutes

Malt, corn, unmalted corn, raw grain, grain (other), maize, maize (flaked), maize (gelatinised), maizone, cerealine,

[1] Minutes of evidence taken before the Departmental Committee on Beer Materials, 1899, p. 381.

sago (ground), torrefied malt, Duttson's malt flour, Beane's grist, Shepherd's corn malt, rice, rice shells, rice flaked, rice gelatinised, rice desiccated, rizine, sugar, saccharum, glucose, glucose from sago, glucose from raw grain, glucose from maize, glucose from potato starch, glucose and gelatine, glucosine, molasses, raw sugar, cane sugar, honey, viscosoline, dextrine, malto-dextrine, black malt sugar, saccharin, (240) saccharin (coal-tar product) is not allowed. It is strictly forbidden.

Hops and its Substitutes

Hops, quassia, Colombo root, camomiles, hop substitutes.

Chemicals

Vitriol, salt, bisulphite of lime, salicylic acid,[1] magnesia, tannin, sulphuric acid, chalk.

Colouring Matters

Colouring, caramel, caramelised dextro-maltose, dextrinous caramel.

Clarifying Matters

Finings, isinglass, fishy matter (sole skins).

Sundry and Stimulating

Liquorice, grains of Paradise, Guinea pepper, *Cocculus indicus*, (297) *Cocculus indicus* is also not permitted to be used.

The incessantly repeated efforts of some members of Parliament to obtain legislative power to stop this method of brewing from refuse substances have all failed in view of the influence of the drink traders.

[1] "It appears to be a common custom to preserve ale and beer by the addition of salicylic acid. The use of this drug for this purpose is everywhere recognised as harmful and unjustifiable."—*Report of the Massachusetts Board of Health*, 1894.

It is stated that 1,868,000 acres of land in the United Kingdom are under barley cultivation for brewing purposes,—producing annually 65,000,000 bushels of barley; and that 19,000,000 cwts. of foreign barley are also used annually in this country for the production of alcohol. Now it takes about 6 lbs. of barley to make a gallon of ale,[1] and the solid matter in a gallon of ale amounts to but half a pound, of which only a small part, *i.e.* the sugary and albuminoid portion, can be called nutritious. Therefore it appears that the conversion of 6 lbs. of nourishing barley into

(1) A small amount of nutritive material, and

(2) A larger amount of non-nutritious material—(alcohol, extractives, etc.)

is, economically speaking, a matter of great waste, and so long as England contains human beings in need of cheap food, it is a waste that should be strongly discouraged by the nation.

Distillation

Thus far we have dealt only with the conversion of sugary liquids into alcohol, and have shown that where the alcohol present reaches 13 per cent no further alcohol can be formed by the yeast cells. Therefore, in order to obtain alcohol of a strength

[1] One gallon of ale consists of:
- water, about $8\frac{1}{2}$ lbs.
- alcohol, $\frac{1}{2}$ lb.
- extractives and salts, 4 to 5 oz.
- maltose, 2 to 3 oz.
- albuminoids, $\frac{1}{2}$ to $\frac{3}{4}$ oz.

more potent than 13 per cent, another process known as "distillation" has to be followed.

The principle is simple, *i.e.* that of heating a fermented liquid so that the alcohol (the lightest portion) is driven off in the form of vapour, the water being left behind. This vapour is collected and condensed again to the liquid condition by means of passing it through a long coil or "distiller," which is cooled by a water jacket.

At first this "distiller" always contains some water in addition to the alcohol, but, if needs be, it is quite easy to repeat the process several times, and in this way to obtain pure alcohol practically free from water.

Malt whisky is prepared from malt and yeast as previously described,—the liquid containing alcohol being finally run into a "still" and "distilled" as raw whisky.

For making such distilled liquors as whisky, gin, or "Schnapps," the starch is obtained from rye, maize, or oats, or from potatoes or beet-root.

Originally whisky (or at any rate Scotch whisky) was manufactured solely from barley malt, and this is still the case with some of the whisky distilled in the Highlands in pot-stills. At a moderate computation, roughly two-thirds of the spirit vended nowadays as "whisky" is derived from other materials, chiefly maize (Indian corn) and refuse molasses. The spirit obtained is (or should be) called "grain" or "patent" spirit, the word "grain" referring to the materials, and the qualification "patent" to the type of apparatus in which this variety of alcohol

is distilled. This spirit, made from different materials by a different process, has "by-products" that, as might have been anticipated, are different. . . . Nevertheless this new spirit is sold as whisky both at home and in the Colonies, and is used for blending with malt whisky, the blend being in some instances so labelled as to give the purchaser the impression that it is malt whisky. . . . It is known in the trade that much of the so-called whisky most carelessly made from the cheapest materials is exported to West Africa and other tropical colonies, where it is sold under Government sanction to native races.—(Extracted from the Report of the Whisky Commission instituted by the British Medical Association.)[1]

In the preparation of "patent" spirit various artificial means are used. For instance, alcohol may even be obtained from sawdust, which is first converted by means of acids into a fermentable sugar, which is then fermented. In addition to the recognised "still" and patent spirit of commerce, there are on the market certain cheap spirits artificially concocted from alcohol, prepared from inferior material and carelessly purified, and containing sometimes, besides the alcohol, other ingredients of a harmful nature.

The Massachusetts Board of Health reports (1894) that tannic acid was found in excess in 5 out of 37 samples of whisky.

Fusel oil in noxious amount is occasionally to be found, and it is also rarely present to a distinctly appreciable extent in beer.

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[1] See *Journal of British Medical Association*, December 26, 1903.

Rum is made from a mixture containing molasses, which is fermented and then distilled.

Gin is made in practically the same way as whisky, but the distilled liquor is in addition re-distilled with juniper berries, turpentine, coriander seed, or a variety of other flavouring materials.

Wines

Wines differ from spirits or distilled liquors in that they are prepared by the fermentation of fruit juices, chiefly the fruit of the vine. For many centuries this was the only source of wine, and even now people generally imagine that grapes form the basis of the ordinary wines of commerce, although it is well known that there have not always been sufficient grapes grown in Europe to supply the quantity of wine that is drunk. At one time, owing to the ravages of the phylloxera, other ways of providing wine had to be invented, and various methods came into vogue: it became, in fact, a fine art to combine alcohol with coloured liquids (turmeric, logwood, and other dyes being used), and these decoctions, being duly flavoured, were labelled as "wine."

Since the brilliant discovery of Pasteur, whereby the destruction of the vines was stopped, the demand for these made-up wines has been less urgent; but, nevertheless, we need to be on the alert as regards their existence, because some of them are more intoxicating than ordinary wines, containing as they

do a somewhat larger percentage of alcohol than exists in wine prepared from grape juice alone.

Unfermented Wines

The ancients appear to have used as a drink the fresh juice of the grape which had not been put through the process of fermentation. "And Pharaoh's cup was in my hand; and I took the grapes, and pressed them into Pharaoh's cup" (Gen. xl. 11). This quotation with its context seems to show that the juice of fresh grapes was frequently enjoyed in the unfermented state, and proves therefore that when the word "wine" is used by ancient writers it does not necessarily refer to an alcoholic beverage, although undoubtedly fermented wines were also in use. In the present day unfermented wine is prepared on a large scale in Switzerland, Australia, and other places, according to one or more simple methods.

Method of preparing Unfermented Wine.—The grape juice, before it has had time to ferment, is heated to a certain point and then placed in sterilised vessels, which are sealed so that no micro-organism can enter. Hence, as no fermentation occurs, alcohol is not formed.

Grape juice can also be prevented from fermenting by other methods, *e.g.* :—

(1) Application of cold. (Grape juice will not ferment at a temperature below 50° C. or 40° F.)

(2) By addition of antiseptics, such as salicylic, boracic, sulphurous, benzoic, and cinnamic acids.

It must be noted in passing that certain products labelled "unfermented wines" are made in a somewhat different way, whereby a little alcohol is added to ensure their "keeping."

This addition of alcohol to liquids which are nominally non-alcoholic takes place to no small extent in the preparation of patent medicines and drinks. It very seriously adds to the amount of alcohol consumed by the nation, an addition which various Governments are beginning to realise and taking steps to prevent.

CELL-LIFE

"The organism is not an individual but a social mechanism—always bringing us at last to cells."—VIRCHOW.

"It is a valuable method in physiological science to reduce a problem to the simplest terms possible. A unicellular organism is millions of times simpler than a human body; still all fundamental functions and processes, such as nutrition, growth, reproduction, excretion, appear similar in both. Hence by studying the influence of alcohol upon these functions in simpler organisms, evidence may be gained by which more clearly to interpret the human experiment."—Prof. C. F. HODGE, Ph.D., Clark University, America.

CHAPTER III

CELL-LIFE

(To some of our readers the subject of cell-life may seem elementary. These we would direct to the latter portion of this chapter, where we deal with the direct action of alcohol upon plants and animals.)

The Cell the Tissue Unit

In discussing the action of alcohol upon the body, we shall so constantly use the word "cell," and refer to the "protoplasm" of which it consists, that it seems essential to introduce here a few words on the subject of cells and cell-life, and on the protoplasm which forms the basis of every part of our actively living body.

The bodies of all plants and animals are built up of very small forms of matter called cells. Some microscopic animals, the very smallest that we know, consist of only one single cell which has all the work to do—the feeding and excreting, the moving and the feeling. But by far the greater number of animals are built up of many thousands or millions

of these cells, and when there are so many the different duties are distributed among them. This is, of course, the case with our own bodies, which are built up of many many millions of these cells arranged in organs, each with its own duty to perform.

These cells are very minute, many of them being not more than $\frac{1}{3000}$th of an inch in diameter; they can, therefore, be seen only with high magnifying powers of the microscope; but with the help of a microscope we are able to see them quite easily, and we can observe what happens to them when they are normally working as they ought, and also when there is something which is interfering with that work.

In the case of plants the particles which comprise a plant are called cells, because the protoplasmic body is placed in a box or cell of substance firmer than the protoplasm it surrounds. This firmer material is called cellulose. In plants, therefore, it is quite correct to call the elements cells. In the animal body, however, the protoplasmic cells are more or less solid, and are, as a consequence, frequently also spoken of as corpuscles, the word corpuscle meaning "a little body."

Cells

In the simpler forms of life cells are few in number, in fact, in the simplest form of all (*e.g.* the amœba and certain bacteria) the animal or plant,

as the case may be, consists of one cell only, which carries on all its functions in a complete though elementary way.

Inasmuch as it is the life of individual cells which forms the ultimate basis of the complex phenomena constituting the life of a human being, we do well to study the structure of these very simple forms, such as the amœba, seeing that the foundation material of which all cells are made is indeed the same, and that in these primitive forms we can more readily follow out that life-history, which after all is the type of the life-history of all cells, however complex their structure and function. Moreover, in these simple forms we can study with especial accuracy the effect of foreign substances upon the protoplasm which is the substantial basis of all cell-life.

The Amœba

The animal organism known as the "amœba" is a minute particle of jelly-like material which lives in stagnant water, and can be seen if a drop of such water be examined under the microscope. It is capable of slow movement, pushing out processes, first in one direction and then in another.

Careful watching shows us that the amœba absorbs (or takes in) tiny particles of food, and also excretes (or gets rid of) its waste material and anything it does not need. Further, it has the power of dividing, and thus producing a new generation of amœbæ.

In *structure* this minute mass of moving jelly-like material consists throughout of a living substance called protoplasm—the name always given to the elemental material out of which all living animal and vegetable matter is formed, and which is composed of albuminous substances or proteids, salt,

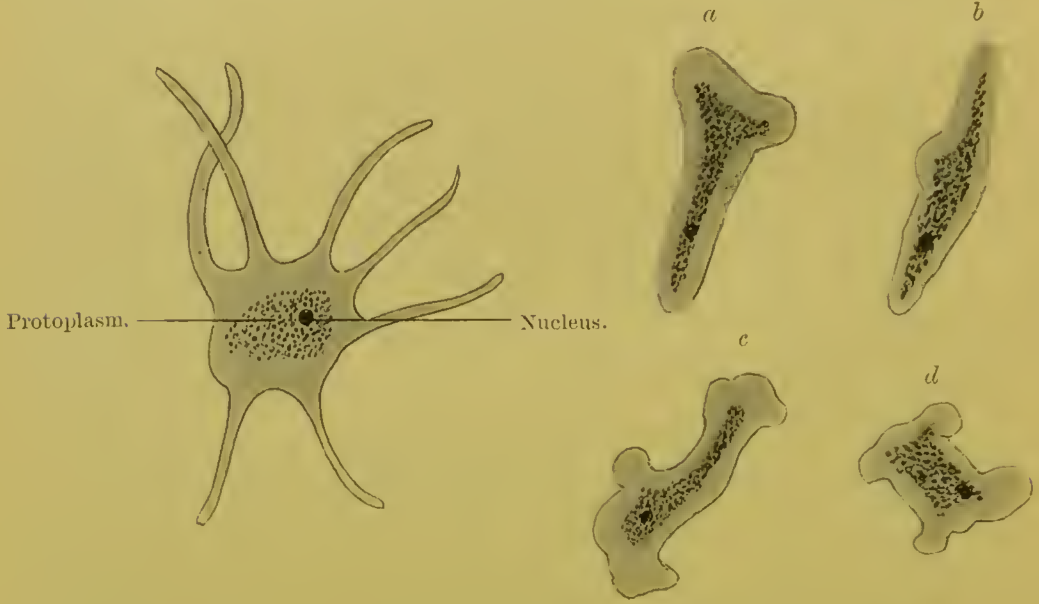


FIG. 4.—The drawings are taken from two specimens of an amœba. That on the left hand shows the animal actively throwing out processes by which it drags its body from place to place. That on the right, a group of four figures, shows the various shapes *a*, *b*, *c*, *d*, successively assumed by an amœba while under continuous observation under the microscope. From *Practical Zoology* (Marshall and Hurst), by kind permission of Messrs. Smith, Elder, and Co.

and water. The term protoplasm, or living protoplasm, implies always a power of life, vitality, and change.

In the centre of the small mass of jelly which forms the amœba is a rounded body which we term the *nucleus*, also consisting of protoplasm, the survival of which is essential to the life of the cell, as it takes the leading part in the subdivision and

multiplication of the cell. We shall see later how both the body of the cell and its nucleus are each affected by alcohol.

Specialisation of Cells, which, however, still consist of Protoplasm

As we pass higher up the scale of life we find an enormous increase in the number of cells required to form an animal.

In these higher forms certain cells are set apart in groups for certain objects, and consequently we find some of them manufacturing special juices, some entirely concerned with carrying messages to the brain, some acting as blood-cells, and so forth. For this reason the mere outside appearance of cells is very various (see diagram), but we wish to emphasise the point that, in spite of difference in shape and size, the foundation of all cell-life is the same, namely, protoplasmic; and that it is exceedingly important for the protoplasm of each individual cell to be vigorous, in order that complete life and health may be experienced by the organism as a whole.

It is not altogether easy to picture at one moment the individual lives of tiny cells, and then to think of them as massed together and acting together in thousands, forming the organs and tissues of the body. Perhaps the best way in which to gain an idea of this question of aggregate cell-action is to imagine our bodies as being like a great nation consisting of many millions of people, working at many

sorts of industries. Some of the inhabitants are concerned with the reception into the country of food and other raw material; the duty of others is to work up this food, so that it can be made use of by the people as a whole. Others, again, are concerned in the transport or carrying of this material from place to place, others in its storage, and so on.

It is the same with these cells of which our bodies are built. For instance, it is the duty of certain cells lining the stomach and bowels to take in food, whereas other cells are concerned in breaking it up, in storing it, as in the liver, or in passing it on, as in the blood-vessels, and so forth.

Now, just as the work-people of a nation are collected together into factories, so the cells of the body are packed into organs, and these organs do their work either well or badly according to the condition of their individual cells, whether these are healthy or are more or less exhausted, degenerated, or poisoned. This health of the cells of the body depends, therefore, wholly on the condition of the protoplasm and nuclei of which the cells consist. In the Plates and figures may be seen types of various cells, from the simple blood-cell to the complex brain-cell.

Bodily Vitality dependent upon Healthy Protoplasm

If in any cells or groups of cells the normal activity and vitality of the protoplasm of which they consist is depressed by a drug, or by the presence of retained products of excretion, then assuredly the

general level of vitality of the whole organ will be more or less impaired. In applying this fact, it is well, whenever thinking of the human body, to strive always to think in terms of the protoplasm of which the cells are actually made, and of the agencies and circumstances which affect protoplasm either advantageously or otherwise; for the broader the view we gain of this subject of cell-vitality, the nearer shall we be to the understanding of those conditions which lead to good health and prolongation of life.

We are now in a position to see first what is the general influence of alcohol on cell-life.

Protoplasmic Poisons

The more recent observations of the direct effect of drugs on cells constitute our knowledge of what are now termed "protoplasmic poisons," and are leading to discoveries of the utmost importance to mankind, opening up as they do an infinite range of possibilities in the way of learning how to avoid those things which are injurious to human protoplasm. The whole trend of sanitary medicine is to determine the presence of, and to extirpate such poisons, whether in the air we breathe or in the food and drink we take for nourishment, or whether insidiously conveyed by microbes the germs of disease. These germs owe their dangerous properties to the fact that they produce poisons (or toxins) which are now well recognised scientifically as powerful depressants of the nervous system of higher animals. Many of this class of

protoplasmic poisons, *e.g.* the toxin of diphtheria, are themselves striking illustrations of a vicious circle; for in such cases the effect of the poisonous products on the bacteria themselves is invariable, viz. that in cultures they check the growth and activity of the organisms which give rise to them. Another example of this is seen in the cessation of the growth of the yeast plant when a certain amount of alcohol has been formed (p. 30). Of course, this is only an instance of the physiological law that the waste products of the cells of a tissue, by their accumulation therein, hamper, damage, and ultimately destroy (by degeneration) the cells themselves.

This raises at once the question, In what way does alcohol behave towards living protoplasm so as to impair and disorganise its vital power?

The majority of protoplasmic poisons (of which alcohol is now recognised to be a very prominent one) have the power of primarily interfering with the all-important oxygenation of the protoplasmic tissues. How far they actually assimilate by combination the oxygen which the tissues require is still an open question, but they directly interfere with the powers of these tissues to take up such oxygen as is available. In the case of alcohol, so great is its poisonous influence in this particular that the needed oxidation of the fats and starches taken into the body is interfered with in a most marked way, and with disastrous results in the shape of fatty degeneration and other maladies (see Chap. XIII.).

Alcohol also apparently seizes upon a part of the invaluable oxygen in the blood, and the two form combinations, *i.e.* oxidation products, whereby some of the oxygen is prevented from ever reaching its normal destination. Interference, then, with the fundamental (breathing) function of living protoplasm is the first and most obvious way in which alcohol hampers and checks the vital activities of living cells.

In order to arrive at further generalisations on this question, a large number of very important investigations have been made with regard to the effect of dilute solutions of alcohol upon the growth and activity of animal and vegetable protoplasm, and to these we must now refer in some detail, as they show what extremely small quantities of the drug exert an inhibitory and indeed fatal influence on the processes of life.

Action of Dilute Solutions of Alcohol on the Growth of Yeast and other Plants

One of the simplest forms of cell-life is seen in the yeast plant or *torula*, which consists of a single cell, possessing a power of rapid multiplication by subdivision so as to form glutinous masses which can be partially destroyed without the destruction of their vitality.

The growth of this cell in the presence of dilute solutions of alcohol has been investigated by Professor

Hodge, who has made a long series of experiments and reported the results.

He estimated the rapidity of growth and multiplication of the torula cells both in simple solution and in the same fluid when an exceedingly small quantity of alcohol was added to it, and he found that the rapidity of growth was inhibited and lessened when alcohol was present, as indicated in the following table :—

Effect of Alcohol in checking the Growth of the Yeast Plant (Torula)

Number of Torula Cells found in each **Cubic Millimetre after seven hours.**	**Solution in which the Torula was sown.**
2061 cells	Normal solution containing no alcohol.
1191 cells	$\frac{1}{1000}$ per cent alcohol.
992 cells	$\frac{1}{100}$ per cent alcohol.
852 cells	$\frac{1}{10}$ per cent alcohol.
769 cells	5 per cent alcohol.

Thus we see that the active growth and proliferation of the yeast cells is greatly lessened even by extremely small amounts of alcohol, so that, whereas in the normal non-alcoholic solutions there were 2061 cells, in a mixture containing only one-tenth part of alcohol in a hundred parts of solution, the cells numbered only 852. In the words of Professor Hodge: "The cultures containing no alcohol are seen to win." A still stronger percentage of alcohol entirely prevents the growth of the yeast, and, as we have already pointed out in Chapter II., this stoppage of growth

actually occurs in the manufacture of beer and wine, when the proportion of alcohol reaches about 14 per cent, the organisms, like bacteria, being killed by their own life's product—alcohol.

Effect of Alcohol on Growth of Cress

It has for some time been accepted that the protoplasm of certain plants is sensitive to the presence of narcotics. Dr. Ridge has tested this carefully in the case of alcohol. He placed cress seeds in closed tubes containing exactly the same amount of garden mould, water, and air, and he exposed all the tubes to the same conditions of light and heat.

The liquid in the first tube was only pure water, the others contained certain weak solutions of alcohol.

1st tube, pure water.

2nd tube, water containing one part of alcohol in five thousand parts of water, *i.e.* one drop in about half a pint.

3rd tube, water containing one part of alcohol in a thousand parts of water, *i.e.* one drop in about four tablespoonfuls of water.

4th tube, water containing one part of alcohol in two hundred parts of water.

5th tube, water containing one part of alcohol in a hundred parts of water.

He observed the germination of the seeds, and found, in the first place, that the one part of alcohol in a hundred of water actually killed them, or only permitted germination to commence feebly (Fig. 5).

The smaller amounts of alcohol simply retarded the normal growth of the cress, but even a drop of

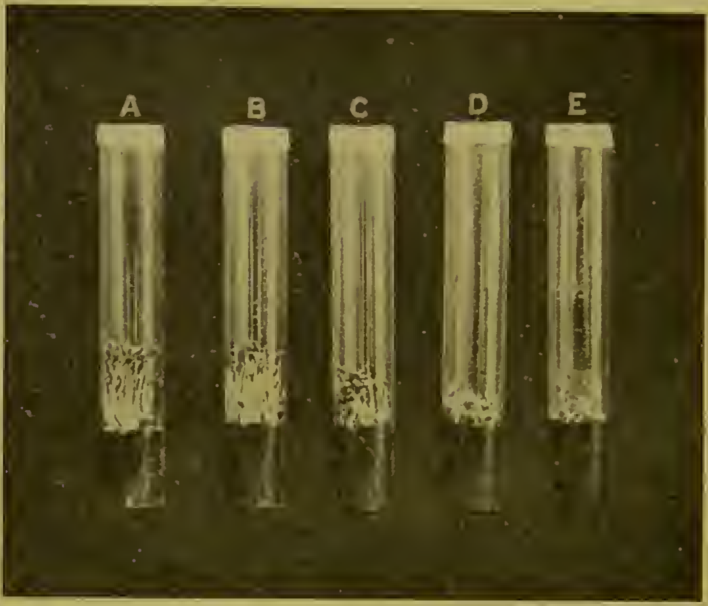


FIG. 5.—Photograph by Dr. Ridge of the growth of cress in tubes containing garden mould (occupying the lowest fourth of the tube), with varying proportions of alcohol as follows:—In Tube A the mould was moistened with pure water only. In Tube B the mould was moistened with 1 part of alcohol in 5000 parts of water. In Tube C, the mould was moistened with 1 part of alcohol in 4000 parts of water. In Tube D the mould was moistened with 1 part of alcohol in 200 parts of water. In Tube E the mould was moistened with 1 part of alcohol in 100 parts of water. The greater failure of growth accompanying the further addition of alcohol in each case is very marked.

alcohol in more than a pint of water at times seemed to act injuriously.

Seeds constantly soaked and watered with dilute solutions of alcohol have their growth retarded even by solutions that are much more dilute than the one per cent previously referred to.

Effect of Alcohol on the Green Colouring Matter of Plants

In addition to retarding the growth of the seeds, alcohol hinders the formation of their green colouring matter.

These experiments have also been carried on with growing plants, as, for example, the geranium.

Dr. Ridge found in the case of the geranium that both the growth and the production of the green colouring matter of the leaves are seriously affected by watering the plants on alternate days for a few weeks, with a one part in a hundred solution of alcohol. Two cuttings from the same plant were placed, as far as possible, under exactly similar conditions. One was fed with a one per cent solution of alcohol every alternate day, the other with water only, and after six weeks the one that had received the dilute alcohol was only about half the size of the other.

Even one part in a thousand of alcohol was found to affect the geraniums adversely; there was less colouring matter in the leaves, and premature withering of the lower leaves occurred.

In another experiment, when Dr. Ridge treated the common *chara vulgaris* with $\frac{1}{10}$ per cent of alcohol (that is, about one drop in four tablespoonfuls of water), the plant began to lose its green colour.

Effect of Small Doses of Alcohol upon the Lower Forms of Animal Life

With regard to animals, it has also been proved that small quantities of alcohol are injurious to animal protoplasm.

Sir B. W. Richardson, M.D.,[1] observed that a solution of alcohol, 1 to 1000, 2000, or even 3000, proved fatal to fresh-water medusæ.

The details of his experiments were as follows :—

Water from the tank of the botanical gardens, in which this little fresh-water jelly-fish lived, was collected in a jar and charged with one gramme of absolute alcohol to a thousand of water. A duplicate of plain jar tank water was placed side by side with the first, and in each a medusa was placed.

On entering the jar containing the alcohol the medusa's swimming movements were seventy-four in the minute, but within two minutes these stopped, and the animal began to shrink and to sink to the bottom of the vessel.

At the end of five minutes the little creature lay at the bottom apparently dead, and although it was put into plain water for twenty-four hours it did not recover. Meanwhile, the medusa in the other jar was active and unaffected.

The experiments were repeated again and again, but they all resulted in proving that alcohol, even diluted to as little as one part of alcohol in a thousand

[1] *Asclepiad*, July 1888

parts of water, affected as a lethal poison the living protoplasm of these lower forms of life.

The action of alcohol on simple, developing protoplasm as it exists in the eggs of insects, reptiles, etc., is very marked. The eggs of a blow-fly kept moist with alcohol and water, one part of the former to three thousand parts of the latter, do not mature as quickly as they normally should, and may not mature at all (Ridge). The same result occurs when the ova of frog-spawn is studied as the test object (Ridge).

Water fleas (*Daphne pulex*) cannot survive more than a very short time when there is even only one drop of alcohol in four thousand of water, though they remain perfectly active and well in ordinary fresh water.

Féré states that even in the case of hens' eggs their development is considerably delayed and disorganised by the presence of even small quantities of alcohol, when applied either in watery solution or as alcohol vapour.

More recently Professor Rauber has published some most interesting experiments on the action of alcohol upon animals and plants. He appears to have been unaware of many of the earlier experiments on this subject, but independently carried out numerous observations on the influence of alcohol in various strengths upon animal and vegetable proto-

plasm, using the alcohol as vapour or in watery solution, and noting its action upon various flowering plants, *e.g.* balsams, pelargoniums, geraniums, petunias, nettles, aloes, larches, begonias, potatoes, etc., and on various animals, *e.g.* hydra, tapeworms, earth-worms, leeches, cray-fish, perch, and other fish, sparrows and mammals, as well as man.

He used much larger quantities of alcohol than did Richardson and Ridge, with the result that in most cases he obtained more markedly fatal effects. Using solutions of from 1 to 20 per cent strength, but working principally with a 10 per cent solution, he found that alcohol acts as a definite protoplasmic poison upon all the forms of cell-life upon which he experimented; that plants become shrivelled and pale; that animals become intoxicated, and that those that live in water soon die. Thus cray-fish, placed in a 2 per cent solution of alcohol, succumb within a single day; perch, placed in a 2 to 4 per cent solution of alcohol, rapidly become intoxicated, fall to the bottom of the vessel, and die, though if they are transferred to pure spring water before the last stage they may come to themselves in the course of a few hours.

These investigations clearly lead in one direction, all observers being now impressed with the fact that animal and vegetable protoplasm is deleteriously affected by even very small quantities of alcohol—

which is, in fact, thus proved to be a drug which is very poisonous to living tissues and cell-life. The bearing of this upon the question as to the effect of relatively small doses of alcohol upon the protoplasm of the human body is obviously most important.

THE NERVOUS SYSTEM

"From the medical and scientific point of view we have this great physiological fact before us, that the first thing alcohol does in 99 cases out of 100 is to affect the mental working of the brain of the man who imbibes."—Dr. CLOUSTON.

"Alcohol diminishes the rapidity of thought, makes the imagination and power of reflection commonplace and deprived of originality, acts upon fine and complex sensations by transforming them into coarse and elementary ones; provokes outbursts of evil passions and dispositions, and in this way predisposes men to strife and crime, and upsets habits of work and perseverance."—Prof. SIKOVSKY, St. Petersburg. *Société Russe pour la protection de la santé publique—Commission d'alcoolisme* (1898-1900).

CHAPTER IV

THE NERVOUS SYSTEM

The intricate guiding and controlling mechanism by which all our bodily functions are regulated and maintained in action is called the nervous system. It is the machinery of our thoughts, our emotions, our memory; it directs the movement, voluntary and involuntary, of every muscle; it controls the secretion of all our glands, and governs, in fact, every function of the body. When the whole body is starved, the nervous system is the only part which at first does not lose weight; in fact, it lives on the other tissues and at their expense. Its influence cannot, therefore, be over-estimated, and it is imperative that every one should possess sufficient knowledge to realise both the importance and, at the same time, the structural delicacy of this part of our body, in order to save it as far as possible from wrong and reckless treatment.

The effect of alcohol on the various parts of the nervous system can only be correctly estimated when the general correlation of these different parts is understood. We must, therefore, preface our discus-

sion of the main issue with a short sketch of the nervous system and its functions.

For this purpose it may be conveniently divided into three main divisions :—

I. The Brain—
consisting of (*a*) Large Brain or Cerebrum,
(*b*) Small Brain or Cerebellum.

II. The Spinal Cord.

III. The Nerves, including the sympathetic nerves.

Each part is continuously connected with the others, and all of them consist of the same highly specialised type of protoplasm, in the form of minute nerve-cells and nerve-fibres embedded in a supporting tissue or framework. An anatomical study of the nervous system must consequently embrace (A) that which is visible to the naked eye, and (B) the cells and fibres which require a microscope for their demonstration.

A. Coarse or Naked-eye Anatomy of the Nervous System

The main relations of the different parts of the nervous system to one another are well shown in Professor Fraser's photograph (Fig. 6) of the head and neck, in which the outer part of the skull and the left half of the lower jaw has been removed, showing the large and the small brain covered with their vascular membranes and with the spinal cord leading thence downwards. From the spinal cord

some of the larger spinal nerves may be seen running out into the neck, and from thence into the upper limb.

I. The Brain

The brain[1] is the dominant organ of the whole

Fig. 6.

body, for not only are all our mental powers dependent on its healthy activity, but even such vital functions of organic life, as the beating of the heart and the movements of the chest to maintain breathing—functions on which life itself entirely depends—

[1] *I.e.* large brain (cerebrum) and small brain (cerebellum) together, see Fig. 6.

are sustained by the activity of the brain and spinal cord. Only when the brain is intact are the processes of thinking, feeling, and willing possible; only when the brain is well nourished and free from poisons can these processes be accomplished in perfection.

The brain not only evokes energy in all parts of the body, but it also controls bodily functions and activities so as to enable the organs to do their work efficiently. In order to carry on successfully this all-important duty of governing or controlling the body, it is obviously essential that the brain should be kept free from anything in the shape of depressing influences, which would hamper its power of co-ordination and determination. Many narcotic drugs, unfortunately, exert this hampering effect.

More than this, it is a matter of supreme importance to every human being that he or she should enter the world with a normal and healthy nervous system; in fact, it ought to be regarded as a national duty to secure for every unborn child a vigorous brain—balanced in its powers, and possessing the potentialities of well-regulated mental action.

At present, much time and energy is devoted to improving the poor mental material of backward children by educational means, but it would be more scientific if we studied diligently the ways and means of creating sound nerve structure at the very start of life, seeing that no amount of subsequent education can make perfect a brain that comes into the world weak in vitality, and with its parts miserably

endowed as to their ultimate power of development.

The growth of the brain continues for thirty years, during which time it is particularly sensitive to the influence of drugs, to over-strain, and to lack of proper food.

From the earliest stages of infancy the factors that ensure the steady and healthy development of a child's nervous system ought to be recognised, in order that a good result may be finally attained in the shape of a self-controlled and reliable personality.

Now two plain physiological facts require emphasis here — first, that there is a profound connection between the structure of the brain and the mental characteristics displayed by a human being; and, secondly, that even the most moderate approach to complete perfection of structure can only be expected if suitable and sufficient nourishment and suitable and rational training be supplied during childhood. In the case of children robbed of sleep, plied with wrong food, and never protected from alcohol and tobacco—their growth and development, instead of proceeding at the normal and rapid rate, proceed but slowly, and indeed become progressively slower as the years go by. School education will be of little avail to counteract the deterioration of a nation, if no means be taken to prevent that insidious undermining of the vigour of its future citizens, which is constantly taking place through ignorance and wrong treatment of the nervous system in childhood and youth.

Situation and Structure of the Brain

The brain (cerebrum and cerebellum) is situated inside the hard bony case known as the skull, which in the adult is strong enough to protect it from all ordinary damage. The skull is lined with one kind of membrane (dura mater), while another much thinner membrane (pia mater, Fig. 6), consisting of a close net-work of blood-vessels, covers the brain, lying in close contact with all its folds, and sending branches of arteries and veins into all its parts.

Through these minute vessels a very large blood-supply is accorded to the brain, this supply being obviously adapted to keeping the delicate nerve tissues steadily provided with the nourishment that is essential for their vitality, and for the evolution of the stream of energy which is constantly rising from the nerve centres.

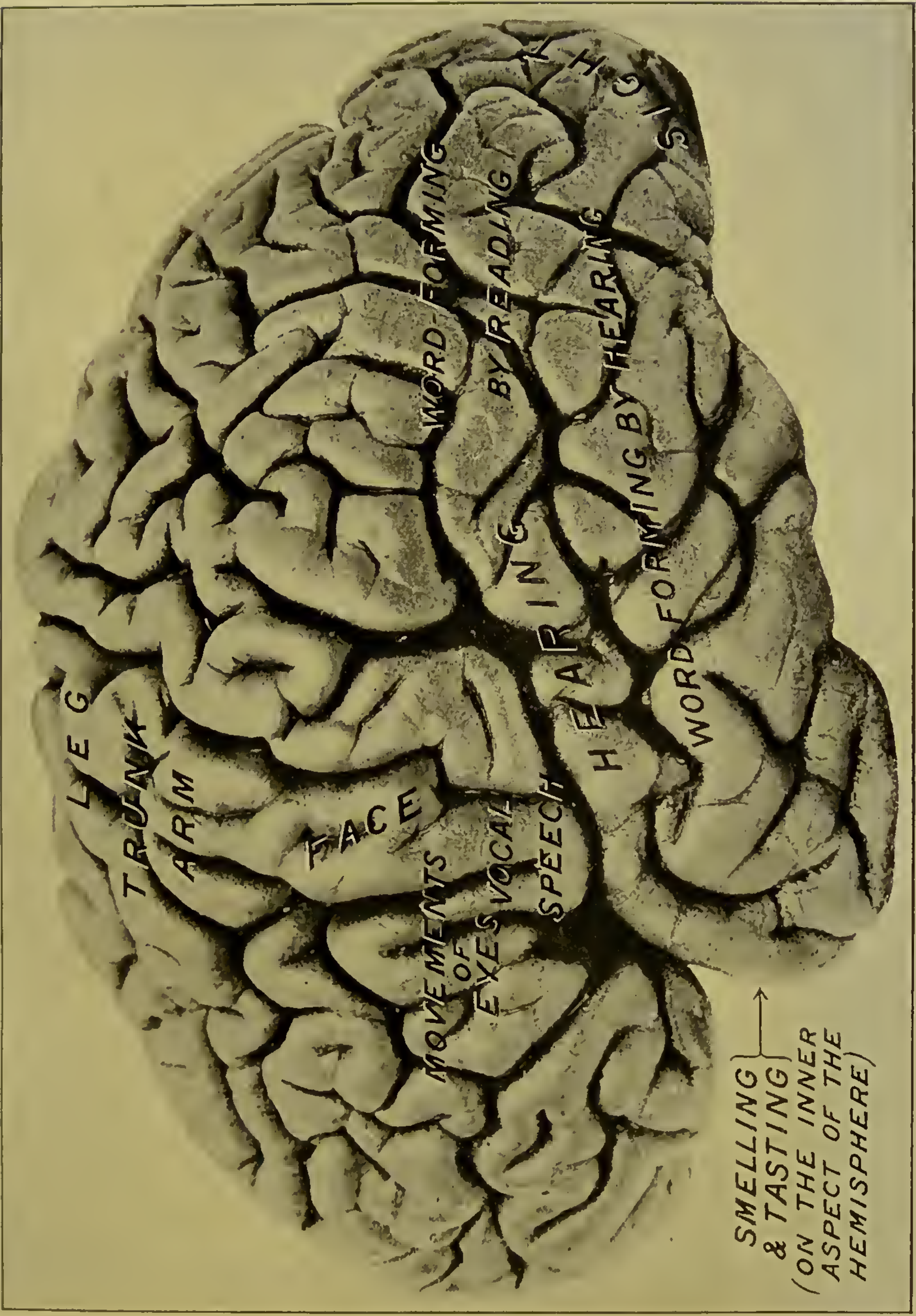
(*A*) The Cerebrum, or Large Brain.

The convoluted surface (Plate III.) (often called the cortex, Lat. = bark) of the cerebrum, or great brain, is composed of masses of minute bodies called nerve corpuscles (Plate VI., Figs. 7, 8), which are grouped together in definite areas or "centres," as they have been usefully termed, and have the two functions of (1) receiving and recording the sensations which are constantly coming in from our sense-organs, the eye, the nose, the ear, the skin, the muscles, etc., and

PLATE III

Copy of a photograph, by Prof. Retzius, of the left half of the human cerebrum, or great brain. The areas indicated by the words written on the photograph serve the functions and parts of the body stated. Thus the word "LEG" means that that spot is the centre for movements of the leg.

PLATE III.



THE BRAIN (*after Retzius*).

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(2) issuing or sending out impulses to the muscles for the production of movement.

Let us now discuss the arrangement whereby the outer surface of the brain provides for the performance of these different acts of our conscious and intellectual life. During the last thirty years, since the epoch-making discoveries of Hitzig, Fritsch, and Ferrier, we have learnt from experiments on animals that a large portion of the brain surface is divided into compartments or areas for different duties ("sensori-receptive areas" and "sensori-motor areas")—while the remaining areas, the functions of which are as yet undetermined, are provisionally spoken of as "association areas," because they are undoubtedly linked together with other regions by connecting fibres.

As all thought, emotion, and volition depend wholly on our sensory impressions, and as there is no consciousness unless the senses are in activity, we will begin with a brief survey of those regions of the great brain which receive sensations.

1. Sensori-Receptive Centres

(*a*) **Sight.**—The pictures transmitted by the nerves of sight from the eyeballs are carried to the hinder or occipital part of the brain, to the area marked "sight" in Plate III.

(*b*) **Hearing.** — The impressions of sound are received and registered in the upper and outer part of the temporal lobe marked "hearing" in Plate III.

(*c*) **Smell and Taste.**—These two senses, which are but feebly developed in man, are also recorded in the temporal lobe on its inner aspect.

(*d*) **Touch and Pain.**—The information we gain from the nerve organs in the skin when touched, or heated, or cooled, or pricked, is in part registered in the sensori-motor (*vide infra*) region of the parietal lobe, but the sense of touch is also recorded in other parts of the cortex, or surface, of the great brain.

In like manner, the records of our movements and delicate sense impressions of tension and pressure coming from the muscles and moving joints are registered in the sensori-motor region.

(*e*) **Space.**—Our judgment of our position in space, and especially our consciousness of balance and accuracy of posture, is founded on special spatial sense impressions which are localised in the temporal lobe, probably in the region just below the word "hearing" in Plate III.

For our consciousness as a whole we depend on the information we obtain when those portions of the brain which record sensation are all in a normal state of activity,—and it is of the utmost importance that this normal activity should be maintained in the highest degree of efficiency when we are awake and at work.

Now such activity depends upon the sensitiveness of thousands of the most highly developed brain corpuscles (shown in Fig. 7) which compose the sensori-receptive centres, a sensitiveness which is essential

if correct impressions from the external world are to be truly recorded. It is obvious that when the smallest doses of drugs are capable of affecting protoplasm chemically, they can hardly fail to affect the sensitive delicacy of these corpuscles.

2. Sensori-Motor Areas

We have seen that the brain centres or stations for receiving sensations from our eyes, ears, etc., occupy, roughly speaking, the hinder and lower part of the cerebrum, and we must now turn to the middle region where are arranged the centres or stations for the issuing of orders to the muscles for the execution of movements. This is the all-important sensori-motor region.

Because this part of the brain is definitely mapped out into different areas, each with a special duty to perform in the way of movement, these areas have been commonly spoken of as "motor centres," but it is to be remembered that the same areas or centres are places where the memory of movements, of touches and muscular strains are recorded. They are therefore not only stations for sending out impulses to the muscles, but are also offices for receiving impressions. In passing, we may perhaps restate the well-known fact that every nerve centre has of necessity a receiving or sensory part and an outgoing or motor part. The centres are definitely arranged in the brain, as shown in the figure. Thus, beginning above and passing downwards, are found centres for

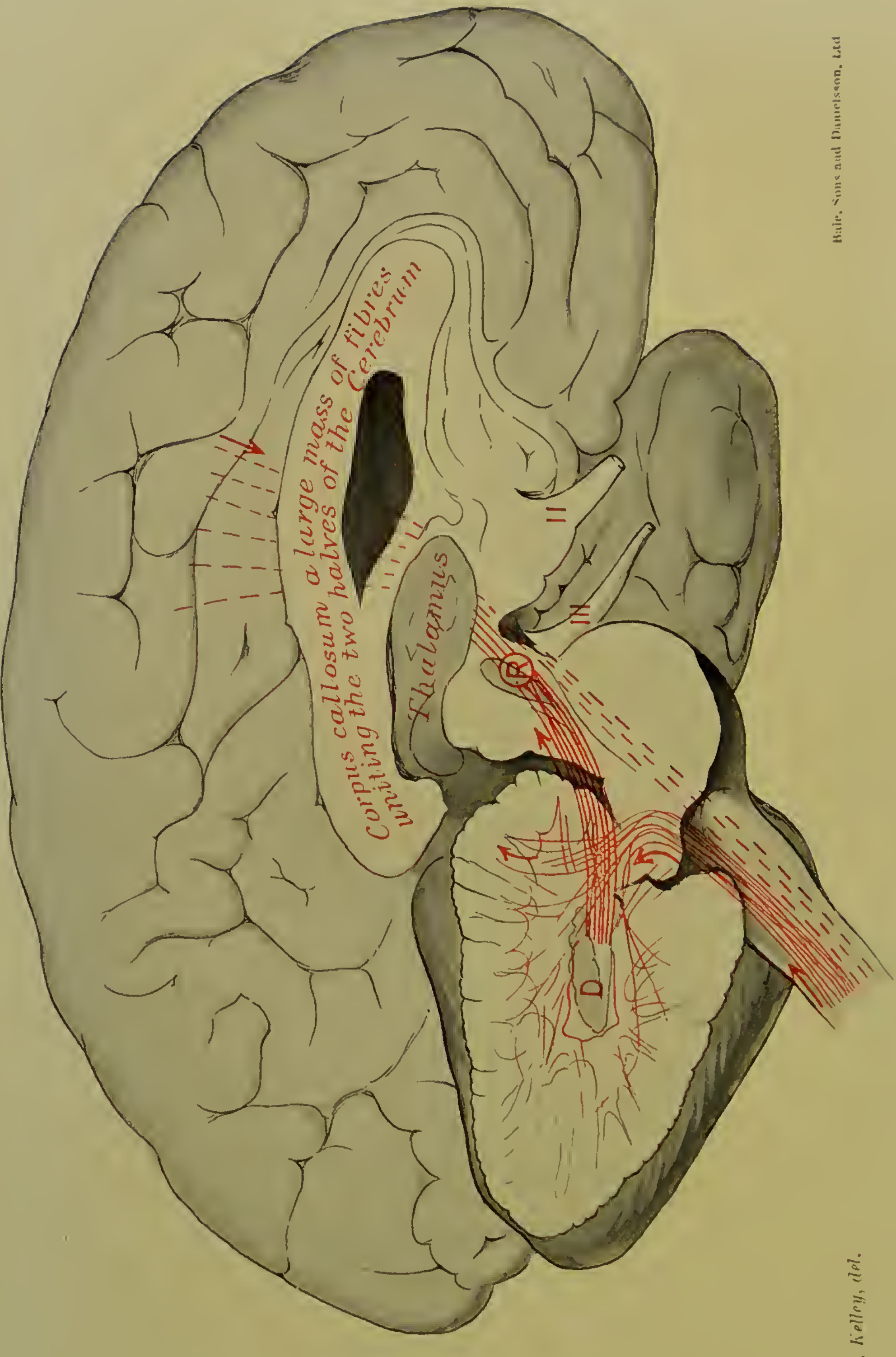
the leg, the arm, and the face. If any of these parts on the surface of the brain are irritated by disease, *e.g.* by a tumour, or by drugs such as alcohol, absinthe, etc., convulsive movements of the corresponding part of the body are liable to occur.

Now the complete function of these motor centres is only acquired gradually and by training during the years of development and growth, for at the beginning of a child's life the centres which control its muscles are not structurally ready for use, and probably only attain complete maturity of action when adult life is fully reached.

Take, for example, the centre for the muscles controlling the lips and tongue, the focus of which is situated at the point marked "vocal speech" in Plate III. Slowly, by a long and painstaking process of imitating and failing and trying again, the child's nerve control over these becomes gradually established, words being spoken more clearly and more rapidly as time goes on. Thus the great faculty of speech is acquired. So, too, in the case of the centre for the leg muscles, a year or even two must elapse before the child gains sufficient "control" over them to enable him to walk across the floor at will.

The explanation of this is, that as the nerve-cells in the centres guiding the legs increase in number and in the complexity of their associations, and as the fibres leading from the brain centre to the muscles obtain their insulating sheaths and the whole

PLATE IV.



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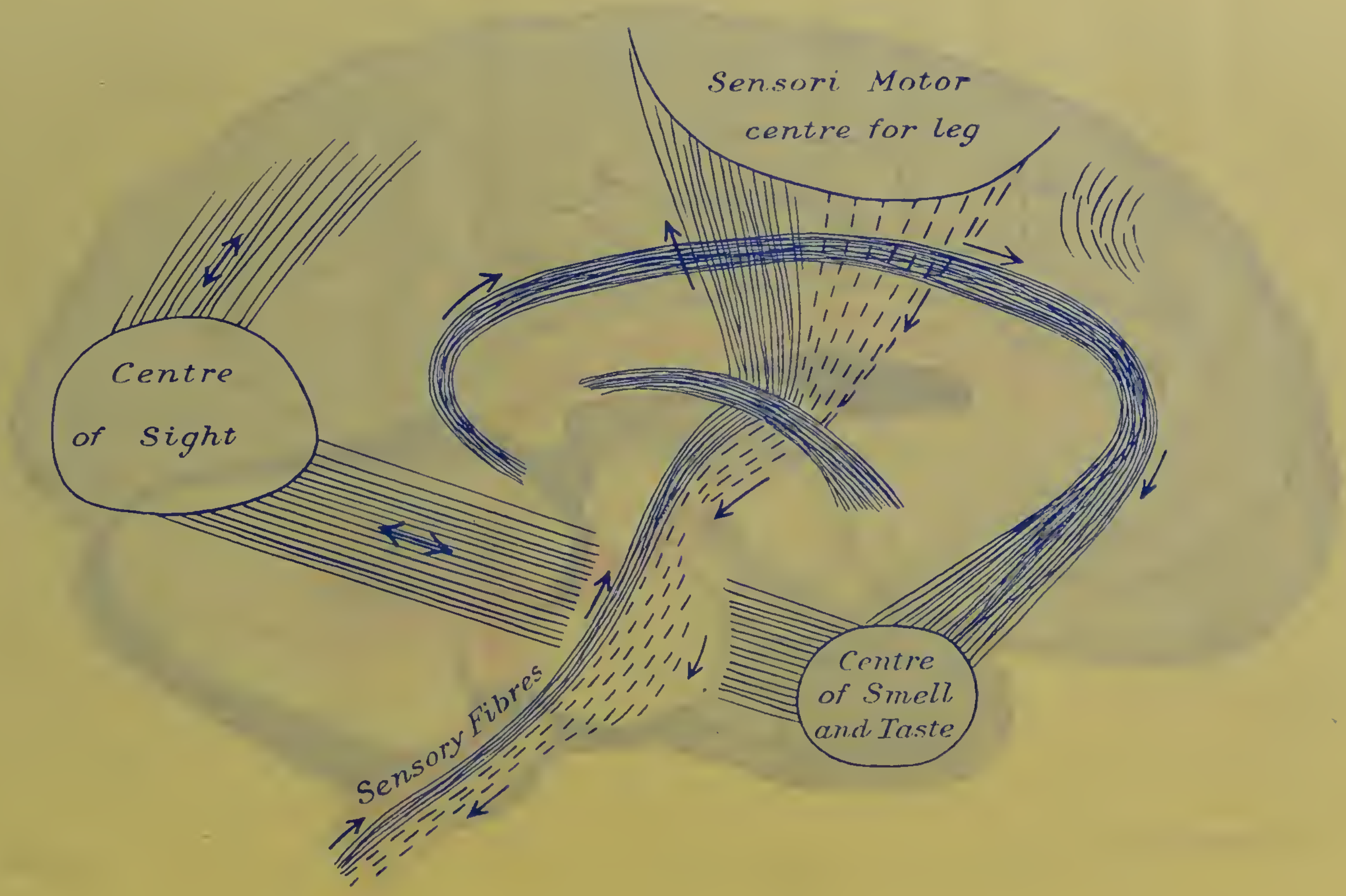
Sensori Motor
centre for leg
Centre
of Sight
Sensory Fibres
Centre
of Smell
and Taste

PLATE IV

Drawing of a dissection of the human brain in which the right half of the cerebrum (the right hemisphere) and a large piece of the right half of the cerebellum have been cut away. The spinal cord is seen entering below. The tracing is designed to show the general course of some of the fibres that enter and leave the great brain, and which connect and thereby associate together the different sense areas or centres. The direction of the small arrows indicates the course which the nerve currents take. The continuous lines represent the ingoing and association paths, the dotted lines the outgoing or motor currents. The connections between the cerebrum and cerebellum are shown in the red tracing. From the grey dentate centre (marked D) in the cerebellum, fibres run up to a centre marked R in the thalamus of the cerebral hemisphere. The spinal cord is also connected with the cerebellum. The figures II. and III. mark the second or optic nerve and the third nerve respectively.

apparatus becomes structurally more complete, the movements of the legs, from being unsteady and erratic, become more and more controlled until the habit of working together is established between the cells which guide the many different muscles involved.

3. Remainder of Surface of Cerebrum

Between the sensori-motor area and the sensori-receptive centres there is a large area lying above the words "word forming by reading" in Plate III., concerning the function of which we are wholly ignorant, and a still larger mass, which constitutes the frontal lobe, which undoubtedly subserves the more complex intellectual operations of the brain.

All mental functions, though possibly at one stage of their production formulated in the frontal region are, nevertheless, the outcome of excitation of the brain as a whole. This is provided for by a rich system of association fibres and channels of communication, as shown diagrammatically in the accompanying Plate. IV.

Within the last ten years it has been shown that these "association fibres" connect the different parts of the brain in the most complete manner, so that the excitation caused by thoughts or ideas arising from stimulation of special sensori-receptive centres can be transmitted to other sensori-motor centres whose duty it is to put "thought into action."

(*B*) The Cerebellum, or Small Brain

The cerebellum, or small brain, works in perfect co-operation with the large brain and spinal cord. It is an organ for the special purpose of helping to co-ordinate the sense impressions we receive from our muscles, and therefore it is essential to the accurate execution of any movement. The way in which we "automatically" walk depends upon the cerebellum, which to a large extent preserves our equilibrium and guides our locomotion, for it is now definitely ascertained that the lower limbs are specially innervated through the cerebellum. Even the simple maintenance of the erect posture is not an easy matter (for to effect this a large number of muscles have to be guided and kept up to their work of controlling the balance of the head and the erectness of the back), while walking is a still more complex movement requiring much practice, and necessitating the pouring out from the brain of constant and varied messages, which direct with unfailing accuracy the frequently altering position of the legs and feet. Inability to control these completely is characteristic of early childhood, when the nerve centres are (as we have shown) in a primitive stage of development. Should, however, such a reversion to the inabilities of childhood take place in an adult, it means either that the cerebellum and allied centres are exhausted by illness or starvation, or that the nervous system is drugged.

II. The Spinal Cord

The great and little brain receive their information and give out their impulses by means of the spinal cord, which is continuous with both, and is composed of bundles of fibres and subordinate nerve centres for the muscles of the trunk and limbs.

It gives off a series of nerves, each possessed of two roots, of which the front one is for outgoing or motor impulses, and the hinder one for incoming impressions and sensations. Hence every spinal nerve is composed of motor and sensory fibres bound together in the same sheath.

III. The Nerves, including the Sympathetic

The nerves are the cords or bundles of nerve fibres which run :—(1) from the skin and sense organs to the spinal cord and brain; (2) from the brain and spinal cord to the muscles and to the organs, *i.e.* the lungs, liver, stomach, intestines, etc. So small are these that a single fibre may be only $\frac{1}{10,000}$ of an inch broad. Those bundles of fibres and collections of nerve corpuscles which are distributed to the internal organs are commonly spoken of as the sympathetic system.

Thus the whole body is associated together and brought under the influence of the nervous system, which on its part is affected by and receives impulses from every corner of the body.

During the whole of life, the messages which come constantly pouring into the brain by means of the nerves travel at the rate of 98 to 131 feet per second (*i.e.* about that of an average express train), the answers being conducted out again to the muscles with a like rapidity.

B. Minute or Microscopic Anatomy of the Nervous System

The nerve corpuscles and fibres which make up the nervous system, *i.e.* the brain, spinal cord, and

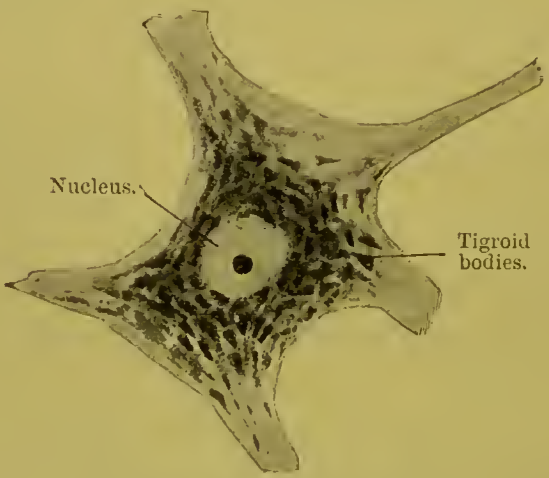

Fig. 7.—Normal nerve corpuscle or cell showing its body substance, the darkly stained particles in which are termed tigroid bodies. Note also the large central nucleus.

nerves, are all constructed on the same plan, though varying according to the function to be subserved.

I. **The Nerve Corpuscle.**—We may take as normal specimens of nerve corpuscles one from a ganglion (see Plate VII.), one from the spinal cord (see Fig. 7), and one from the cerebrum (see Plate VI.).

Each is shown to consist of a protoplasmic body, which can more readily be examined when stained in the laboratory by various methods. This having been done, we observe that the protoplasm is arranged in small, deeply staining masses called tigroid bodies (see Fig. 7), grouped around a central body called the nucleus (see Fig. 7).

The body of the cell gives off numerous branches and one long fibre, which acquires an insulating sheath and then becomes a nerve fibre (*vide infra*). The larger nerve corpuscles are concerned with motor impulses, the smaller ones with sensory impressions.

FIG. 8.—Section of the cerebral cortex (Ramon y Cyal) stained with silver to show the processes of the nerve corpuscles.

Each corpuscle has numerous branches and one special fibre of exit. This is particularly easy to see in a microscopic section of the cerebral cortex, as in Fig. 8, where under a low magnifying power, and by staining the fibres and corpuscles a dense black with silver nitrate, the body of the corpuscles and their branches are well seen.

II. **The Nerve Fibre.**—The nerve fibres throughout the body owe their origin to nerve corpuscles, which are (1) specially modified sense-appreciating

corpuscles, or (2) nerve corpuscles in the brain, or spinal cord, or (3) little collections of corpuscles scattered about the body, known as ganglia.

The nerve fibre essentially consists of a slender thread of protoplasm, which in many places, *e.g.* the brain and sympathetic system, possesses either no insulating sheath at all or an extremely thin one.

The large white nerve-trunks of the limbs, however, possess sheaths, and owe their appearance to

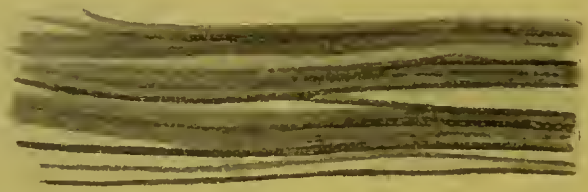

Fig. 9.—Normal nerve fibres moderately magnified.

the fact that each protoplasmic strand is separated from its neighbour by a thick insulating fatty sheath enclosed in a very delicate one. The appearance of a group of fibres, forming together one large trunk, is shown in Fig. 9. In reality the fibres are bound up more closely together, but here they have been slightly separated so as to show their individuality.

THE EFFECTS PRODUCED BY ALCOHOL UPON THE NERVOUS SYSTEM

"This is one of the disadvantages of wine, it makes a man mistake words for thoughts."—Dr. Johnson.

"The powers of conception and judgment are from the beginning distinctly affected, although he who takes the alcohol is quite unconscious that it has this effect. The actual facts are exactly the opposite to the popular belief. I must confess that my own experiments, extending over more than ten years, and the theoretical deductions therefrom, have made me an opponent of alcohol."—Kraepelin.

CHAPTER V

THE EFFECTS PRODUCED BY ALCOHOL UPON THE NERVOUS SYSTEM

The effects which alcohol produces on the working activity of the nervous system may perhaps be best arranged according to the scientific investigations which have been carried out as regards the changes it causes in the intellect, the emotions, the motor mechanism (volition), and the functions of the cerebellum.

This means that in order to appreciate the effects of alcohol on the central nervous system, we must investigate the subject under these four headings :—

(1) The effect on ideation or thought, *i.e.* on the higher psychical functions of the brain.

(2) The effect on the emotions or emotional functions of the brain.

(3) The effect on the nerve apparatus for voluntary action, or, in other words, the effect on the nerve centres which initiate and control voluntary movements. (As it is impossible to differentiate in man the

effect on the muscles from that on the nerve centres, both will be included in the discussion.)

(4) The effect on the cerebellar apparatus for the regulation of such movements.

Part I. The Effect of Alcohol on Intellectual Processes

A. Effect of Large Doses

The main purpose of the present work being to give the experience of scientific observers who have carefully investigated the effect of alcohol, it follows that we shall chiefly refer to the effect of small or moderate quantities only, since the disastrous result of large doses is too well known to require very full description, and too catastrophic to admit of minute analysis. At the same time we must not pass unnoticed the chief features, however trite and notorious, of the nerve symptoms which result from (1) subacute, and (2) severe alcoholic poisoning, respectively.

1. **Subacute Alcoholism.** — Persons who with singular untruth are said to "do themselves well," or who habitually take alcohol between meals, gradually develop nerve changes which reveal themselves at first by loss of energy or lessened capacity for business and diminished attention to detail. Intellectually the brain failure also evinces itself by dulness, stupidity, and unreasonable errors. Such changes, which are due to the slow poisoning of the

highest cerebral centres, are practically never attributed to the real cause; but, when recognised in time, the betterment which ensues on the adoption of total abstinence from alcohol is very striking. If the alcohol habit is maintained, then the cerebral deterioration increases, and may become so established that the subject may entirely lose all power to abstain. We are surrounded by thousands of men and women who are indeed in an early stage of subacute alcoholism, as exhibited by the quality and quantity of their mental power, which is relatively feeble and inadequate because of the lowering effect of alcohol taken in what they deem "moderate" doses. In these people of whom we are speaking all aspects of their psychic life suffer; their intelligence, their sentiments, their will-power are in an abnormal state; the harmonious interaction of the different faculties which go to make up personality being so upset that the temperament becomes altered in a marked way—querulousness, emotional irritability, and unreliability being the prevailing characteristics. As the years go by a certain number of these patients slowly develop a state of chronic alcoholic dementia, which will be described in the next chapter.

2. **Severe Alcoholism.**—If a large dose of alcohol is taken at one sitting, *i.e.* within two to four hours, the symptoms referable to the nervous system are such as are commonly spoken of as drunkenness or intoxication, and the stages of exhilaration followed by brain failure and collapse occur in more or less rapid sequence.

The person becomes for a short time "conversational"; he talks freely, and more or less at random, appearing to himself and to any friends, who may be in the same stage of poisoning, to be "brilliant," whereas his thoughts are really superficial. This so-called stage of stimulation develops into noisiness and emotional excitement as the cerebral control becomes increasingly paralysed. The next change is the commencement of narcosis, and dulness and heaviness succeed. If sleep does not prevent the taking of more alcohol, then serious unconsciousness and even coma may suddenly supervene. Vomiting, however, often sets in at the commencement of the drowsy stage, and by this method some of the excess of alcohol is excreted. If not, and the coma becomes profound, the centres of organic life, *i.e.* of respiration and circulation, become affected, and death may ensue. A demonstration of this is occasionally seen when a man swallows the contents of a bottle of whisky for a wager. He is observed to sink quickly into a state of unconsciousness, all intellectual action being completely in abeyance. Generally the patient can be slightly roused, the contents of the stomach pumped out, and his life saved; but sometimes the coma deepens and death takes place, owing to a paralysis of the nerve centres so profound that the most active measures are of no avail.

3. **Alcoholic Depression and Reaction.**—Now although alcohol is not usually taken in these extreme doses, it is a common practice for persons to

take sufficient to depress their nervous systems in a serious way. Constant evidence of this is seen in the reaction and exhaustion following festivities and convivial opportunities of all sorts. It will be agreed that after a day devoted to holiday-making and enjoyment, a man or woman ought to wake up next morning feeling refreshed and invigorated; yet the very opposite too often occurs. Owing to the alcohol imbibed overnight, the state of the nervous system next morning is one of exhaustion, the brain and, in fact, the whole nervous system being "below par." Amongst other things the nervous control of the heart is impaired, and, as a consequence, that organ acts feebly, and the man feels as he often truthfully remarks "all to pieces."

It is indeed so obvious to even the untrained eye that mental weakness and not mental vigour is the result of large doses of alcohol that we will not labour this point, but proceed at once to the part of the subject which, before it could be fully understood, required exhaustive scientific investigation, namely, the effect of small doses of alcohol upon brain activity.

B. Effect of Moderate and Small Doses of Alcohol

The researches of experimental physiology during the last twenty years into the functions of the brain have now completed in a logical manner our knowledge and analysis of the effect of moderate and small doses of alcohol on those of its centres which

form the material basis or machinery of intellectual ideas. It is clear that in order to investigate the action of alcohol on such a complex process as that involved in mental action we must first start from elementary facts.

Of such facts or principles the most elementary is the generalisation that alcohol and similar drugs attack the more complex living structures and functions before the simpler. That this is a fundamental law in nature is interestingly shown by such observations as those of Overton, who found that when he placed various forms of lowly organisms in the same percentage surrounding of alcohol, those which exhibited the most complex active movements were the first to be depressed, whilst it was only at a later period that the gradual toxic influence of the alcohol abolished the activity of the lowest forms.

So with the nervous system, alcohol attacks first the highest centres and functions, only later overwhelming those of organic life.

To apply the method to the nervous system direct, we begin by giving the brain, when unstimulated, some exceedingly simple task to perform, and then make it repeat this same task after a dose of alcohol has been administered. The activity of the brain in performing any function can be estimated by either measuring the relative times it takes to do some small task allotted to it, under these two conditions respectively, or by estimating the amount of work done in a given time, under the same two conditions,

employing long periods to avoid errors. Research on this subject has been chiefly carried out by Professor Kraepelin and his psychological school at Heidelberg, and what he has accomplished is so valuable that it has given him a pre-eminent position of authority on the subject. The investigations have been continued for many years, partly because every new test had to be repeated many times in order that correct averages might be arrived at.

It will readily be understood that the labour involved in this sort of research is enormous, while much skill is required in planning the experiments, which necessarily involve many considerations and possible sources of error, *e.g.* fatigue, individual differences in the observers, etc.

The amount of alcohol given at a dose varied, of course, but as a rule it amounted to about an ounce diluted with water. Thus it is that Kraepelin's work is so important, since his results were the outcome of small doses of alcohol which, in quantity, in fact, were often far below the amount frequently taken at meals by ordinary individuals, and not infrequently termed a "dietetic" amount.

A very important circumstance in connection with Kraepelin's experiments is the fact that two observers always co-operated in carrying out the experiment. It is impossible to give here the details of the time-recording apparatus, revolving drum, chronograph, and signals used for accurately measuring the rate of mental action in such experiments; but we may

briefly state that, as we know (p. 76) what amount of time is occupied by a message in travelling along a nerve fibre, and as we can easily measure the whole time spent between stimulating one of the sense organs and the making of a responsive movement, all that is necessary is to exclude by subtraction the time occupied in mere transmission along the nerves, and in that way obtain the true time spent by the centres of the brain and spinal cord in appreciating the sensory impulse and acting upon it. This method has been employed by numerous investigators, but by none with more completeness than by Professor Kraepelin, who has thus been enabled to harmonise the apparently contradictory results arrived at by previous observers—a good proof of the controlling and critical value of his researches.

(*a*) Effects of small Quantities of Alcohol on the more Automatic Centres

Kraepelin found that the simple reaction period, by which is meant the time occupied in making a mere response to a signal, as, for instance, to the sudden appearance of a flag, was, after the ingestion of a small quantity of alcohol ($\frac{1}{4}$ to $\frac{1}{2}$ ounce), slightly accelerated; that there was, in fact, a slight shortening of the time, as though the brain were enabled to operate more quickly than before. But he found that after a few minutes, in most cases, a slowing of mental action began, becoming more and more marked, and

enduring as long as the alcohol was in active operation in the body, *i.e.* four to five hours.

In another series of experiments, made before and after the taking of doses of alcohol (averaging as a rule about an ounce) diluted with water, Kraepelin measured the speed with which the processes of simple reading aloud, adding figures in columns both up, down, and also across, calculating arithmetically, etc., were performed. The ability to memorise was also tested. All the circumstances which could have any influence on the result were taken into consideration and allowed for in every experiment.

In all mental work there are two elements to be considered, namely, quality and speed. Now, all observers agree that the quality of mental work is affected by alcohol even before the speed—more mistakes being made. Kraepelin found that it was only more or less automatic work, such as reading aloud, which was quickened by alcohol, though even this was rendered less trustworthy and accurate. In reading aloud we have an example of an almost mechanical motor action; and it is these motor actions that he found to be facilitated at first, especially by small doses; whereas the more involved processes of adding figures rapidly, or of doing mental arithmetic, were not facilitated by taking alcohol, but the reverse.

As an example, we may give the outlines of one experiment.

Half an hour daily for six days was utilised in adding figures, without any alcohol having been taken. The ability to add increased, of course, every day. On the seventh day the experiments were begun under the influence of aleohol. In spite of the influence of the previous day's praetiee, the eapability of adding did not inerease; but instead it began to decrease very rapidly. On the nineteenth day the use of alcohol was stopped, and immediately an improvement manifested itself; but on the twenty-sixth day, when the use of aleohol was resumed, a decided deerease in the power of adding figures again manifested itself.

Memory

With regard to the funetion of memory, alcohol in these doses was discovered by Kraepelin to be distinctly hampering. Various tests were made as to the power of remembering words or numbers. For instanee, persons were set to memorise numbers which were written in eolumns, and required to be repeated again and again until they eould be repeated correetly once. It was found that without alcohol 100 figures could be remembered eorrectly after 40 repetitions, while under the influence of alcohol only 60 figures eould be remembered even after 60 repetitions.

These experiments are confirmed by the experiences of daily life, which show that in the alcoholic person memory is exercised with much greater difficulty than in

normal persons. It must be remembered that memory is one of the later acquisitions of mind, and according to the rule that the latest and most recent faculties of mind are the first to vanish under the stress of poisoning or illness or advancing age, it is but natural for alcohol to cause this early failure. The untruthfulness and inexactitude of those who take alcohol is frequently due not so much to a wilful determination to lie, as to a vague inability to recall accurately events, facts, and promises, for the very reason that alcohol has prevented the cells, upon the activity of which memory depends, from recording normally vivid and exact impressions.

(*b*) Effects of small Quantities of Alcohol on the more highly specialised Functions of Ideation, Reasoning, etc.

When, on the other hand, the higher powers of the mind, *i.e.* those involving association of ideas and the formation of judgments, were called into play, Kraepelin found that there was no real quickening of brain activity under alcohol, but that its slowing effect upon the brain began from the first and continued throughout.

As a simple example we may mention an experiment in which he tested the effect of alcohol on the association of ideas, and the memory of these associations. Words of all kinds, representing objects, ideas, sounds, etc., were printed in bold type and presented to the subject, who had to name some noun which the presented word called up in his mind, and which was associated in his thought with the presented word. An instrument of excellent

device flashed the card up into sight, and then recorded the moment at which the lips spoke the associated word.

During a series of consecutive days at the same hour the experimenter read these words successively, and in the same order, to the subject under experiment, and noted the idea that the word suggested. When at the end of several days the associations were fixed in the mind—when the length of time necessary for the product had reached its minimum—Kraepelin repeated the experiment, sometimes after the ingestion of alcohol, at other times fasting, and compared the associations produced.

He distinguished two kinds of associations—inferior and superior. Inferior associations are due, for instance, to mere sound of words, as gend*arme*, salle d'*armes*; or they indicate co-existence in space or time, *e.g.* horse, girth; noise, smoke of cannon. Superior associations, on the other hand, involve a mental comparison or judgment, or the expression of a quality.

Frequent variations of this method of experiment all tend to prove that alcohol both delays the rapidity of cerebral association and also alters its quality. It favours the production of inferior kinds of mental association, and cuts off higher associations. Hence the operation of the highest function of the brain is interfered with. In other words, small doses of alcohol, from the very first, influence adversely the finer brain cells and centres of latest and highest intellectual development.

Compositors' Work with and without Alcohol

A very careful series of observations made by Dr. Aschaffenburg, on the dietetic use of alcohol in

connection with skilled volitionary work, forms an excellent practical example of the influence of alcohol upon brain activity.

It occurred to Dr. Aschaffenburg to choose for his experiments the work of compositors, which involves rapid thought and accurate muscle response. At his suggestion four men offered themselves for the research. They were all skilled artisans, three of them accustomed to drink moderate ("dietetic") quantities of alcohol, and a fourth who was known to drink to excess occasionally.

Small intervals of time were taken, and the total number of letters composed was first observed under circumstances of normal condition, from which the necessary preliminary averages and observations of fatigue-effects were obtained.

The nature of the result is shown very clearly in the accompanying table (Fig. 10), which gives in four groups the relative figures for the number of letters set up on four successive days in four quarters of an hour by these four men.

On the first and third day they had no alcohol, and their work is represented by the solid black columns. On the second and fourth days they had a small dietetic quantity of alcohol, and the dotted columns in the table represent the number of letters composed by each compositor after he had had this dose. The plain skeleton outline which projects beyond each solid column represents what the same man was calculated to be able to do in the time allotted for

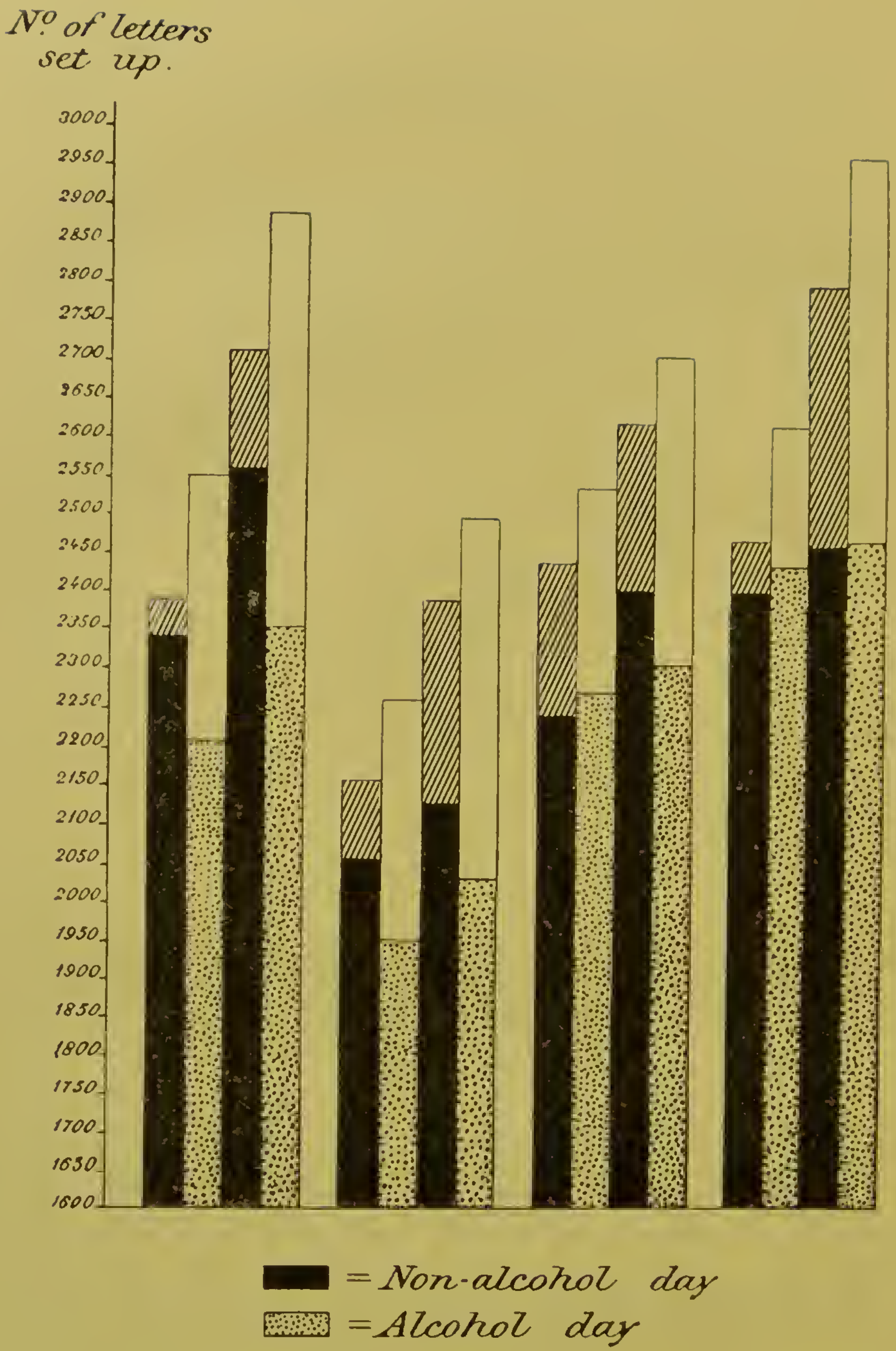

FIG. 10.—Diagram copied from Dr. Aschaffenburg, showing the influence of alcohol in affecting the number of letters set up by compositors. The skeleton outline at the head of each column shows what each man was expected to accomplish. The proportion of non-achievement, *i.e.* inefficiency caused by the alcohol, is striking.

the test. Thus in the case of the first man—on the first day he might have been expected to set up 2390 letters, whereas he set up 2339, *i.e.* 51 less. On the second day, owing to the effect of practice, he might have been expected to set up 2554 letters, whereas he only set up 2212, or 342 less. Here the impairment of mental activity caused by alcohol is well shown.

In reviewing the results, Aschaffenburg says :—

> "The impairment was only absent in one experiment out of eight. It amounted in the other experiments to between 10·6 per cent and 18·9 per cent, upon an average 15·2 per cent of the output which might have been expected without fatigue and loss of practice. On the other hand, fatigue alone created a deficiency of 6·5 per cent on the average of the expected output."

Thus we see that the actual loss of working power was 8·7 per cent (15·2 minus 6·5).

Throughout this whole experiment the men believed that they were doing better and quicker work when taking alcohol than when abstaining, although the actual facts were the reverse. This, of course, is the constant delusion which occurs as a result of the action of most narcotic drugs (see p. 12).

Another investigator, Fürer, studied the duration of the effect of alcohol in light doses, such as is contained in two litres of strong beer or half a litre of Grecian wine, and found that the result lasted all the following day, causing a dulling of mental labour,

although the subject was under the impression that his work was as good as usual.[1]

The results obtained by these two observers obviously confirm those of Kraepelin.

Effect of Alcohol on Intellectual Judgment

The value of our intellectual judgment entirely depends upon our power of recalling experiences, comparing possibilities, and, in fact, of using all the associative links in the brain. When alcohol cuts off some of the wider and more important of these links, and thus limits the range of mental vision, our judgment, as Professor Kraepelin has proved, is the first thing to fail.[2]

That the powers of conception and of judgment are from the beginning distinctly affected unfavourably by alcohol is not usually recognised, although here and there we are glad to find a philosopher quietly noting its real effect. Thus Herbert Spencer remarks : " Incipient intoxication, the feeling of being jolly, shows itself in a failure to form involved and abstract relation of ideas." Schiller was wont to say, " Wine never invents anything," and Helmholtz, one of the greatest observers and thinkers of the nineteenth century, noted in himself the effect of alcohol in interfering with the highest powers of thought and

[1] *Neurol Centralblatt*, 1895.

[2] An everyday example of this error in judgment is shown in failure to recognise when to stop taking alcohol. A man who has taken one glass of beer is to that extent less competent to judge whether he ought to take another.

conception. At the celebration of his seventieth birthday in Berlin, when the Courts of Europe and the whole scientific world joined to confer upon Helmholtz numerous honours, he described in the course of a speech the conditions under which his highest scientific thoughts had matured and come to fruition :—

"Frequently they slyly enter the mind without one's immediately attaching any importance to them ; later some very simple accident or circumstance may be sufficient to reveal to us, when and under what circumstances they arose, or they may be present without our even knowing from whence they came. At other times they come to us suddenly, without any exertion whatever, just as an inspiration. As far as my experience is concerned, they never come to a wearied brain, or at the writing-desk : they were especially inclined to appear to me while indulging in a quiet walk in the sunshine or over the forest-clad mountains, *but the smallest quantity of alcohol seemed to scare them away*" ("Die kleinsten Mengen alkoholischen Getränke aber schienen sie zu verscheuchen ").

This limitation of the range of thought by alcohol is a matter of common interest, because it is observed constantly in daily life. For instance, when alcohol has been taken, any mental effort which necessitates the rapid recalling of an event or of an abstract ideal or thought becomes often slightly more difficult. Ordinary uninteresting conversation along routine lines can still be carried on, although the brain is in that slightly paralysed state in which the strictly accurate comprehension of broad facts and their bear-

ings is impossible. Persons in this condition rarely make really instructive conversationists, because their powers of mental association are not fully available, owing to the partial inaction of their higher brain centres.

Effect of this Limitation of Mental Activity upon Business and other important issues

Sometimes such people are vaguely conscious of their inability to think effectively, and therefore they procrastinate and decline to deal with business matters which require their attention. At other times they fail to recognise their own mental obfuscation, and consequently make erroneous decisions and plans, often to their own disadvantage. Alcohol both narrows down and makes less definite the normal field of mental perception. It causes a "loss of the sense of awareness of surroundings."[1]

Such lessening of mental acuity may prove to be a serious factor when evidence is required in courts of law, because the testimony, although *bona fide*, may be unreliable.

Comparatively slight numbing of the higher mental faculties often proves to be a matter of grave importance when the lives of others are at stake. Extremely serious, for instance, are those wrong decisions and wrong orders given on board ship or before a battle, when everything depends on the

[1] T. Claye Shaw, M.D., F.R.C.P., "Psychology of the Alcoholic," art. in *The Drink Problem*, 1907.

absolute reliability of the brain in command. It must be remembered that, as a rule, only those behind the scenes are possessed of information sufficient to decide whether or no any given disaster can be attributed to the action of alcohol, and even then expert knowledge of the action of drugs on different persons is essential before a correct estimate of the situation can be arrived at. Too often this element in the case is ignored.

Surgical Accidents due to Cerebral Confusion or Mental Obfuscation produced by Alcohol

The number of accidents which come under this heading is simply appalling. Many are due to the irritant action of alcohol, which leads men and women to attack and injure other human beings. Numberless other accidents are the result of falls, miscalculations as to distance when moving about amongst machinery, unsteadiness of gait, shakiness of arm and hand, etc. —all these being due to the depressing and poisonous effect of alcohol upon the brain and the nervous system generally.

Some years ago (1884) Dr. A. G. Miller, F.R.C.S.E., surgeon to the Edinburgh Royal Infirmary, made a careful statistical report concerning the incidence of accidents admitted on different days of the week during the year 1880. As the public-houses are closed on Sunday in Scotland,[1] excessive drinking is limited to Saturday after wages are paid :—

[1] There has been Sunday closing in Scotland for fifty years.

Average number of accidents per day	. . .	5·65
„ „ „ each Saturday	. .	8·38
„ „ „ between midnight on Saturday and 6 A.M. on Sunday	. .	1·88

This makes the average total for Saturday and Saturday night 10·36, *i.e.* nearly double the daily average of accidents throughout the week.

Between 6 P.M. on Saturday and 6 A.M. on Sunday the average was 6·08, whereas between the same hours from Sunday to Monday the average was less than 1 (*i.e.* ·9 per cent).

Injuries to the head occurred four times as frequently on Saturday nights as on ordinary nights, and on Sundays there were practically none.

In another group of cases the surgical accidents are clearly traceable to mental inertia in alcoholic parents, which leads to the neglect of children, who consequently scald and burn themselves in a terrible way.

Again, innumerable accidents are due to nothing else but mental stupidity and slowness on the part of persons who normally have "their wits about them," but who, in consequence of taking alcohol, do not quickly enough grasp the bearings of a situation, with the result that an accident occurs. In Belgium it is calculated that 43 per cent of the accidents in mines and factories are due to alcohol. In America (although the amount of alcohol used on that side of

the Atlantic is very considerably less per person than in the British Isles) stringent regulations exist on some of their largest railways as regards demanding total abstinence while the men are on duty. It is desirable that a similar regulation should be made in England. Meanwhile, we know only too well that every year thousands of accident, casualty, and emergency cases due to alcohol are brought to our hospitals for treatment.

Looking at the matter from the merely pecuniary and charitable standpoint, it is obvious that if hospitals could be relieved of these "created" demands upon their funds and space, a considerable amount of subscribers' money would be saved annually, and at the same time the energies of doctors and nurses would be expended in a more satisfactory direction than in healing patients whose accidents are in reality avoidable.

Duration of Effect of Small Quantities of Alcohol

Kraepelin describes an investigation by Rudin made to determine how long the intellectual abilities continue to be depressed after the immediate toxic effects of alcohol have had time to pass off. The experiments showed that the effect of a single dose of alcohol taken in the evening persisted until the morning and noon of the next day.

Kürz's experiments on himself were conducted through twenty-seven days in the following manner: On the first six days no alcohol was taken; on the

following twelve days he consumed each evening 80 grams of alcohol in water; then followed five days alcohol free, two with alcohol, and finally two alcohol-free days. On each day he made one series of association and perception experiments, and added and studied for half an hour. He found that after the twelve days' alcohol period there was a decided diminution in the day's work in calculating, as well as in studying. This effect persisted until the fifth day of the alcohol-free period. A single large dose acts for twenty-four and even forty-eight hours, and the regular use of such doses produces, even in a few days, a prolonged reduction in working capacity.[1]

By these and other experiments Kraepelin has positively proved that small quantities of alcohol, diluted with water, lower the quality of intellectual work, and that this deterioration is due to a slight acute poisoning of the nervous system.

Delusive Subjective Sensation of Increased Mental Efficiency under Alcohol

Before he began the investigation of complex reaction periods, involving greater thought, Kraepelin had always shared the popular belief that a small quantity of alcohol (one or two teaspoonfuls) had an accelerating effect on the activity of his mind, enabling him to perform test operations, as the adding and subtracting and learning of figures more

1 *Wiener klinische Wochenschrift*, October 17, 1900.

quickly. But when he came to measure with his instruments the exact period and time occupied, he found, to his astonishment, that he had accomplished these mental operations not more, but less, quickly than before, thereby showing that alcohol has a primarily deceptive influence on the mind, and interferes with the power of forming correct judgments, that it is, in fact, a false witness.

Numerous further experiments were carried out in order to test this matter, and these proved that *alcohol lengthens the time taken to perform complex mental processes*, while by a singular illusion the person experimented upon imagines that his psychical actions are rendered more rapid.

Explanation of this Illusion

This error of judgment probably means that the superior cerebral centres which alcohol progressively paralyses cannot, when immediately under its influence, carry on their work, part of which is to estimate the condition and functional activity of the inferior brain centres.

As a consequence of taking alcohol there occurs enfeeblement of this power of accurately appreciating the different conditions of activity (*i.e.* the rate at which they are active) of these lower centres, and so it comes about that the observer is unable to make a correct estimate of his own doings, his thoughts and actions, which, as a matter of fact, are taking place more slowly, although he is under the impression that

he is thinking and acting more quickly and better than usual.

Undoubtedly, when tried by the touchstone of experiment, alcohol is shown to be a delusive agent, thus proving the accuracy of Solomon's statement that "wine is a mocker."

Similar Deception caused by other Narcotic Drugs

The same phenomenon occurs with ether and other narcotic drugs, so that it is not limited to the alcohol member of that group of substances. As an illustration of this may be quoted one of the common subjective sensations produced by small doses of the ordinary anæsthetics used in surgery, *e.g.* chloroform and ether, namely, that the patient possesses great muscular strength, and feels himself to be making powerful efforts, which in reality are not in any way superhuman and are readily controlled by the bystanders.

Drug deception does not occur merely in the intellectual operations of the brain, for we find it also in the emotional sphere; witness the idea which so often pervades the mind of the taker of alcohol, that his company gives pleasure to others and is acceptable to them, whereas in reality this is frequently untrue.

Other Illusions

The sensations of comfort and well-being which often result from drinking wine, beer, or spirits, are similarly deceptive illusions, for the surrounding com-

fortless circumstances are not in any way decreased, the only alteration that actually takes place being a deadening of the power of estimating adverse and disagreeable conditions. In a normal state a man strives to improve his surroundings, or else to remove himself and his family from what is bad and unwholesome, but under the illusive influences of alcohol he is ready to rest satisfied and let things remain unaltered and drift, or even take a downward course.

Fatigue

Another familiar deception occurs when the sense of fatigue after exertion is dispelled by alcohol. The idea naturally suggests itself that the exhaustion is genuinely relieved by the drug, which in reality only acts as a deadening agent to normal sensation. The average effects of fatigue, which should induce a man to rest and recuperate, are still present, and have a cumulative influence if proper repose and sleep are not taken.

In this respect it is extraordinary to see how many individuals waste their rare opportunities of holiday and recreative repose in taking alcohol, losing thereby all chance of beneficial change and physiological repair. As in this country the consumption of alcohol on bank holidays appears to be slightly on the decrease, it may be hoped that such much-needed intervals of rest taken by the workers are now of more profit to themselves and consequently to the nation.

Alcohol a Cause of Nervous Debility

In this connection it is important to point out that nervous debility—or the sense of it—is frequently caused and accentuated by the moderate use of alcohol. Much of the nervous exhaustion of the present day would cease to exist were alcohol eliminated from the dietary of the people.

Why Alcohol has been considered to be a Stimulant

The fact that our impressions under alcohol are false and deceptive is of very great importance to us in endeavouring to understand how a substance which paralyses like alcohol can also apparently "stimulate," and so gradually lead to the habit of taking it for successive stimulations. As we have already said, alcohol is not peculiar in this respect; chloroform, and some of the drugs which send the brain to sleep, have the property of causing a sensation of temporary initial stimulation or excitation. It is indeed this temporary sense of stimulation and exhilaration which is sought after by the victims of morphia and alcohol alike. In the case of both, this sensation of betterment is chiefly due to a slight deadening of the higher centres, where keen appreciation of discomfort is recorded. Under alcohol the power of appreciating sensations is somewhat lowered; for instance, the feeling of wretchedness or of nervousness before an impending effort is somewhat deadened, and hence the percipient

feels cheered and "more himself," and it is little wonder that he imagines himself to be stimulated, and has regular recourse to the drug when in difficulty. Most particularly does this occur in women at the climacteric period, or what is known as the change of life. The sense of the special nerve symptoms which render many a life miserable for one or two years during the "change," is readily drowned for the time being by alcohol, and it is no wonder, therefore, that women for such reason contract the habit of constantly turning to it, unless they are aided and relieved by proper medical treatment.

Again, in the case of acute pain or shock the numbing of the sensory nerve-cells by alcohol makes the patient feel somewhat less ill (*e.g.* apparently stimulated). In this case the feeling of relief after taking alcohol may be partly due to the dilatation of the cerebral blood-vessels.

It ought to be added here that, in spite of the seeming helpfulness of this sedative action on the brain cells, there is always danger in giving alcohol in any form to persons suddenly "taken ill," for wrongfully administered, the indiscriminate giving of alcohol may induce hæmorrhage from a cerebral blood-vessel. It should be administered only by a doctor, who can diagnose the cause of the attack, and who would hold himself responsible for untoward results.

In many instances the ill-advised habit of hastily giving alcohol as a so-called stimulant has simply accelerated loss of life, and in countless other cases

has inaugurated the fatal tendency to habitual "stimulation."

Tea and Coffee not Depressants of the Nervous System

We cannot conclude the discussion of this commonly received expression "stimulant" and "stimulation" without reference to the general misconception which seems to prevail on the subject. Thus tea, coffee, wine, beer, spirits are sometimes all spoken of as "stimulants." Scientifically, such confusion together of substances which have a totally different physiological effect on the body is unwarrantable. Tea, cocoa, and coffee have no depressant after-effect. Their exhilarating influence has no reaction stage to follow, neither do they cause degeneration of the tissues of the body: hence they are entitled to be called "stimulants."

> "So far as scientific experiment goes, tea is proved not to weaken but rather to stimulate the mental power of the brain-cortex. Its use in moderate quantity is not followed by any injurious reaction, and is not prejudicial to any of the functions of the body." [1]

On the other hand, alcohol in all its forms has a prolonged depressant after-stage, and insidiously sets up widespread tissue degeneration, for which reason it is a misuse of terms to call it a stimulant. Alcohol, as we have already pointed out, is a narcotic, and, like other narcotics, possessed of transitory so-called "stimulant" properties. (See Chap. I.)

[1] *Hygiene of Mind*, T. S. Clouston, M.D.

THE EFFECTS PRODUCED BY ALCOHOL UPON THE NERVOUS SYSTEM

(continued)

"Intemperance does not necessarily mean only obvious and palpable drunkenness. From the very moment in which alcohol has disturbed the healthy exercise of the mental faculties, or has impaired the moral sense by unduly exciting the animal passions, or has in any way unfitted a person for discharging his duties in the proper struggle for survival, from that moment has there been guilt of intemperance."—T. B. Hyslop, M.D., Bethlehem Royal Hospital for the Insane, *Encyclopædia Medica*, art. on "General Paralysis."

"I am firmly convinced that if drink were eradicated, this court (the Divorce Court) might shut its doors, at any rate for the greater part of the time."—Sir Gorell Barnes, 1906, President of the Divorce Court.

CHAPTER V (*continued*)

THE EFFECTS PRODUCED BY ALCOHOL UPON THE NERVOUS SYSTEM

Part II. Effect of Alcohol on the Emotions

The paralysing effect of alcohol upon the higher powers of the brain is strikingly illustrated in those common ebullitions of the emotions uncontrolled by reason which occur under its influence. By the emotions we mean transitory mental disturbances of the balance of thought, tending to pass into irresponsible action unless guided and restrained by the judgment. Thus love, joy, ardour, courage, hate, fear, rage, passion, all seek expression which, unless directed by reason, may become a danger; love turning into passion, joy into orgy, ardour into impatience, and courage into recklessness.

Effect of Alcohol on Self-control

Self-control is one of the highest functions of the brain, and the racial power which results to a people as a consequence of the individual practice of self-control cannot be estimated too highly. Therefore we train our children as far as possible to control

their emotions and their actions, in the hope that ultimately they may become worthy members of the community.

Now the effect of alcohol in diminishing and breaking down this acquired self-control may be seen in every condition of social life, undoing the work of all educationalists and parents.

By deadening the brain-cells, wherein are registered the ideals on which we depend for calmness of judgment, alcohol causes serious lapses of self-control in many people, especially in young adults. Quite small doses are often responsible for the commission of reckless self-pleasing actions, and for the inordinate sway of the passions, which are no longer kept in full control by the higher powers of the mind, because these are more or less in abeyance as the result of the paralysing effect of the drug. When the effect of the alcohol has passed away and the higher nature again asserts itself, the consequences of such actions have to be faced, and these are frequently so far reaching in their effect as to mar the moral and physical trend of many lives, especially those of women and children.

Controlling Mechanism of the Brain

If we analyse the psychical evolution of this all-important faculty of "control," it appears that during the growth of the nervous system there is gradually developed in its highest centres a balanced controlling force which is of essential value in regulating the liberation of energy, just as the governing mechanism

which controls and steadies the action of an engine is of value in preventing it from going at an abnormal and headlong speed,—a speed that leads to undue friction and wear and tear. So too, in the man whose brain cells are poisoned by alcohol, its valuable controlling mechanism is no longer at work; it is more or less paralysed. Consequently the possessor of secrets becomes communicative and "friendly," revealing his own and the affairs of other people in a way that would never occur if his normal powers of reasoning and self-control were in full working order.

Effect of Alcohol upon the Emotional Powers of the Mind

The effect of alcohol on the emotions will be recognised at once if we describe, for instance, the emotional developments in a woman who is fond of its use. They are usually as follows: her temper becomes irritable and fractious, hysterical outbursts are common, and she becomes absurdly timid and full of strange fears. She romances and exaggerates, and invariably denies that she drinks. Any bereavement or strain causes nervous prostration. The most insignificant things are a trouble, and her days are miserable because her power to work effectively is gone. She requires to get "wound up," so to speak, in order to accomplish the most simple matters, and immediately afterwards she collapses both physically and emotionally. Her power of self-control is gravely impaired.

In the case of men the manifestations are, as a rule, somewhat different,—hilarious outbursts followed by surly behaviour and irritability being of common occurrence. During the stage of excitation and of what is foolishly known as a "jolly" condition, the man loses his self-control and frequently his self-respect. In this state, though not being actually what is understood by the term "drunk," he says what is exaggerated and often untrue, and his actions and deeds are liable to become careless and even immoral.

Under a somewhat larger dose this same man is liable to think, talk, and shout excitedly, and even to sing or utter absurdities, all of which symptoms are often termed convivial.

From this stage of "exaltation" the passage to the next of quarrelsomeness and irritability is usually only a question of time or of further dosage, the personal equation of the drinker also being a factor. In this condition the emotional manifestations of hatred, fear, and jealousy are constantly aroused, and innumerable crimes have been committed by persons who, although in this phase of alcoholism, are not in the least "drunk" in the accepted sense.

Deadening of Normal Parental Emotions and Consciousness of Duty

Closely allied to the emotional state of moroseness and savagery is that of callousness to ordinary social duties and to the human obligations of life. The cries of cold and hungry children make no impression

on a brain dazed with alcohol, no normal parental feelings occur, and no emotion of affection or desire to protect is aroused by the sight of a suffering child.

In this connection we may justly dwell on the similar drowning of the consciousness of duty or sense of responsibility which results from the habitual use of alcohol, and leads in extreme cases to a disregard of all sense of honour and rectitude of dealing. Those whose lives are immoral depend greatly on alcohol for this deadening of conscience, and of the normal sense of duty to the social body or community.

So, too, the abstract ideals of the duties of citizenship, etc., which are registered in our higher brain centres and recalled when needed, are the first to disappear from the field of consciousness when the brain-cells are subjected even to small doses of alcohol. Thus it happens that, although sorely required, the ideal often fails to rise clearly to the mind, lower inclinations assert themselves, and in the failure of the individual is seen an example of the decadence of a nation. Even when the ideal is still present, the indolence caused by alcohol renders difficult any action that may be needed, and consequently the *laissez-faire* attitude often wins the day.

It is recognised by all workers for social happiness and reform amongst the poor that the greatest barrier to their efforts to uplift the people around them is alcohol—which, deadening all higher thought and

reducing those who have become dependent on it to a state of mental and moral inertness, destroys that personal initiative which is essential for the restoration of the vigour and enterprise of the nation.

Alcohol a Cause of Suicide

The depressing effect of alcohol upon the brain is further seen in the habitual wretchedness of many who resort to its use. After its very brief excitant effect on the nervous system passes off, there follows the prolonged stage of depression or "reaction" which is frequently intolerable to the drinker. To this and the steady impoverishment of the whole body of the alcoholist many cases of suicide are due. The verdict "whilst temporarily insane" often represents the fact that the brain, owing to the action of alcohol, has temporarily lost its capacity for energy and control, so that a hopelessly emotional and morbid outlook upon life and its possibilities alone remains.

It is quite possible that the mental depression is due both to the direct action of alcohol upon the brain cells and also to its power of interfering with metabolism, in consequence of which various products of delayed excretion poison and depress the nervous system.

A clear statistical proof of the connection between alcoholism and suicide is given by Professor Hillier[1] of Kiel, who reported autopsies on 300 suicides, and

[1] Hellenius, *Die Alkoholfrage.*

found from examining the bodies that nearly one-half of the cases were alcoholists. He considers this a minimum estimate, as the use of alcohol among the young suicides, although adequate to cause severe mental depression, could not have produced sufficient pathological and anatomical changes in the internal organs for these to be observable in the post-mortem examination. The following table shows that the large majority of the older suicides were alcoholists:—

	Number of Males.	Alcoholists.	Females.	Alcoholists.
Under 30 years .	63	14 (22·2%)	41	1 (2·4%)
Over " .	167	123 (73·6%)	29	6 (20·7%)
Total .	230	137 (55·2%)	70	7 (20·7%)

Dr. Sullivan, *Medical Officer in His Majesty's Prison Service*, drew attention in 1900[1] to the connection between increase of suicides or suicidal attempts and alcoholism.

Alcoholic suicide is more impulsive and occurs at an earlier average age than suicide from other causes, and it is the opinion of Dr. Sullivan that alcohol is to blame for many tragic deaths, whereby the community is robbed of valuable and comparatively young lives. According to this authority, "in 220 consecutive observations of such attempts the proportion due to alcoholism was found to be 78 per cent, the usual condition present in four-fifths of the

[1] *Journal Mental Science*, April 1900.

cases being drunkenness supervening on chronic intoxication.[1]

A large proportion of those reported as "found drowned" are what we know as "chronic alcoholics," the tragedy being due either to melancholia or to inability to avoid an accident because of the narcotic effect of alcohol on the brain centres.

Connection between Alcohol and Crime

We cannot here fully refer to the vast subject of the intimate link between alcohol and crime, although the etiology of crime essentially includes perversion of the emotions. It is of such vast importance to the community that it ought to be a matter of investigation by the State in conjunction with the medical profession. In Sweden, one of the countries where this has been recognised, the connection between alcohol and crime has been the subject of a thorough official research covering a period of ten years.

This has revealed the fact that among 24,398 men, who in the course of the decade 1887-97 were sentenced to work out their sentence at hard labour or as prisoners, there were 17,374, that is 71·2 per cent, who connected their crime with the use of alcohol.[2]

In a similar investigation in the state of Massachusetts,[3] the number of persons arrested between

[1] *Alcoholism*, by W. C. Sullivan, M.D., p. 55.

[2] Hellenius, *Die Alkoholfrage*.

[3] *Twenty-sixth Annual Report of the Bureau of Statistics of Labour.*

August 21, 1894, and August 20, 1895, was 26,672. In 17,575 of the cases drunkenness alone was the crime; in 657, or 2 per cent of the cases, there was drunkenness in connection with some other crime; while of the 8440 cases sentenced for other crimes, 43 per cent of these were committed in a state of greater or less intoxication. Concerning 4294 of the crimes committed in a sober state of mind, it was stated that drunkenness had in the first place led to their inception and commission, and in another large group the drunkenness of others was said to have led to the commission of the offence.

The following English figures[1] show the connection between drinking and crime in England and Wales:—

> The number of persons tried for indictable offences was 58,444, and for non-indictable offences 745,252, making a total of 803,696. The figures for the preceding year were 57,068 and 730,613, total 787,681.
>
> Drunkenness accounts for 230,180 as against an average for the five preceding years of 213,803. This is an increase of 20,272 over the year 1902, which is partly owing to new powers given to the police under the Licensing Act which came into force in January 1903.

In an investigation made by Dr. Sullivan concerning "200 male offenders convicted of murder or of grave homicidal attempts . . . the number of cases in which the criminals were of alcoholic habits amounted to 158, and in 120 of these, or 60 per

[1] *The Judicial Statistics, Part I. Criminal Statistics for 1903.*

cent of the whole series, the criminal act was directly due to alcoholism."

In a larger group of 500 cases of less serious character, chiefly aggravated assaults, he found that 82 per cent were attributable to alcohol. In nearly all the homicidal cases and "in four-fifths of the minor offences the intoxication had attained a fair degree of chronicity." [1]

With regard to the painful subject of sexual crime, this authority asserts that "in rather less than half the cases either chronic alcoholism or simple drunkenness is the causal condition."

In places where the taking of alcohol is prohibited the number of arrests for crime falls at once. This was strikingly seen during the recent terrible earthquake at San Francisco, when Mayor Schmitz "issued an order forbidding any person to sell, give away, or drink alcoholic liquors. The result was that with thousands of homeless people in the city and thousands of visitors coming into the city, the arrests from April 20th to July 4th, 1906, were from two to six per day. In all the turmoil and the confusion of the tens of thousands of homeless people, and the influx of thousands of visitors, perfect order prevailed, and the police force, according to their own statement, had nothing to do. . . . The first Monday after the re-opening of the saloon in San Francisco (July 9, 1906) there were 74 victims before the police courts, as against 5 on the

[1] *Alcoholism*, by W. C. Sullivan, M.D., pp. 162-164, etc.

previous Monday; 72 on Friday, as against 2 on the previous Friday; and the second Monday 113, as against 3 or 4 the second Monday before re-opening. . . . Extra policemen were asked to protect the defenceless refugee women and children, and extra guards were stationed at the camps to protect the homeless."—(From *The Pioneer*.)

All this points to an enormous amount of mental obliquity and cerebral irritation attributable to alcohol. Thousands of our population never allow their brains to get into a normal state of physiological activity, but are constantly preventing this by taking alcohol. As a consequence they look at life from an abnormal and a distorted point of view, which leads too often to the commission of some breach of social law and order.

Pleasurable Effects of Alcohol

It is often argued that the pleasure obtained by taking alcohol outweighs its evil effects. This may be considered from two points of view. First, it must always be remembered that any temporary oblivion from trouble and anxiety obtained by taking alcohol is counterbalanced by subsequent reaction in the form of mental depression, and physical wretchedness, which render the sufferer more unfit to cope with the difficulties of life. Secondly, the depressant effects of alcohol upon the highest centres of the brain, and its influence in causing intellectual lethargy and sense of fatigue, co-operate with the former causes

to lessen the normal capacity for genuine enjoyment and pleasure.

For the sake of the national physique it is most unfortunate that the passive enjoyment of sitting in a stuffy public-house, dimly conscious that there is a feeling of weight in the legs when moved, is thought by so many to be comparable with the active enjoyment of those who have full control over their limbs, and can spend a holiday rowing or cycling, and obtain the maximum of enjoyment because they have the use of their powers.

While it is customary to recognise and lay stress upon the pleasurable states induced by alcohol, it is equally customary to refrain from exposing the unhappiness and misery frequently introduced into home-life by the nervous irritability which is often manifest in those who take so-called moderate quantities.

In these persons, the small events and annoyances of daily life bring on an amount of nervous upset and irritation out of all proportion to the original cause. The onlooker recognises this disproportion, but not so the patients themselves, who consider their irritability and indignation absolutely justifiable, so entirely, for the time being, is their sense of the relative importance of things blurred and altered by the morbid condition of their brain.

It is, moreover, one of the properties of alcohol to blot out events from the memory. In these people. consequently, the recollection of their own tiresome-

ness passes far more rapidly away from their minds than it does from the minds of their friends, who cannot help regarding them coldly even when their normal and affable manners have returned.

The real price paid by many a man and woman for the alcohol they take is undoubtedly the price of partial estrangement from their nearest relatives. Add to this the needless anxiety and worry endured by these same relatives, and then let us decide whether any initial pleasure to be gained by taking alcohol is worth all this risk and loss.

Is the applause of a gathering (consisting often of persons themselves incapable of keenly appreciating genuine intellectual achievement) worth buying at the price of the alienation of the home circle, which is called upon to suffer when the subsequent reaction inevitably takes place?

Action of Alcohol upon the Emotional and Intellectual Condition of Animals

Alcohol is found to affect the brain centres of the lower animals in a way similar to that which occurs in man. Thus various observers have noted that when alcohol is given to dogs — even in small quantities — their character alters, fear and nervous irritability taking the place of their normal high spirits. Professor Hodge reports as follows with regard to his investigation on dogs, in which with great care two sets of identical animals were chosen, and to one group alcohol was given in dietetic

quantities, while the other group—the control experiment—were not given any (see also Chap. XV.) :—

"A striking result of the entire research, and one entirely unexpected on account of the small doses of alcohol given, has been the extreme timidity of the alcoholic dogs. . . . The least thing out of the ordinary caused practically all the alcoholic dogs to exhibit fear, where the others evinced only curiosity or interest. Whistles and bells, in the distance, never ceased to throw them into a panic, in which they howled and yelped, while the normal dogs simply barked. This holds true of all the dogs that had alcohol in any amount. During the first year of the experiment Bum (one of the alcoholic group of puppies) had a number of paroxysms of causeless fear with some evidence of hallucinations. He would apparently start at some imaginary object, and go into a fit of howling. With the discontinuance of alcohol in the diet the more acute features of this reaction have subsided, leaving, however, the characteristic timidity as a habit of life that does not seem to wholly fade out."

So, too, from similar experiments upon kittens Professor Hodge reports as follows :—

From the beginning of the experiments

". . . it was remarkable how quickly and completely all the higher psychic characteristics of both the kittens dropped out. Playfulness, purring, cleanliness, and care of coat, interest in mice, fear of dogs, while normally developed before experiment began, all disappeared so suddenly that it could hardly be explained otherwise than as a direct influence of the alcohol upon the higher centres of the brain." [1]

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[1] *Physiological Aspects of the Liquor Problem.*

Dr. Magnan of Paris describes even more marked symptoms in dogs, larger doses being given. Under alcohol, a dog

"... does not respond to caresses but snaps at kindly attempts to stroke it ... at night, when all is still, it cries and whines plaintively, and cannot be reassured by its master's voice; frequently it is necessary to bring a light into the room before it can be quieted. At this time it also suffers much from insomnia and from other symptoms, which in the human subject are characteristic of the condition known as delirium tremens."

Further proofs of the profound emotional disturbance caused by alcohol will be found in the chapter on nervous diseases. In this present section we have merely sketched in broad outlines the wide range of upheaval due to an underlying central cause, viz. alcohol, which too often escapes unrecognised.

Part III. Effect of Alcohol on the Neuro-Muscular System

In the following pages we intend to discuss the effects which alcohol produces on the output of the body in the shape of muscular work during the performance of what are termed voluntary acts.

Fortunately a very large amount of scientific observation has accumulated on this branch of the subject, but it must be recognised at the outset that the great majority of experiments have been made on the whole body, *i.e.* on the nervous system, central and peripheral, as well as on the muscular

system. Whatever effects have been observed, therefore, relate not merely to the muscles, which are, of course, the active motor agents, but also to the nerves and nerve centres, which originate the movement and excite the activity of muscles by sending impulses thereto.

The muscular tissue forms the largest constituent of the body, for it constitutes in an average adult man 43 per cent of his weight.

In every action the muscles contract, and thereby liberate heat, their energy of contraction being provided by the oxygen and soluble food-stuffs brought to the muscles by the blood-stream. The exact and very complex manner in which these food-stuffs combine chemically in the substance of the muscle is not yet fully understood. We know, however, that the muscles are constantly using up starchy food, and forming as waste matter carbonic acid gas and other waste products, and that in normal circumstances, as a result of such work, they maintain or even increase their power, their tone, and, in some cases, their size.

With regard to these three points, it is important to discover the influence of alcohol when taken daily, for it is a matter of fundamental physiological interest to ascertain whether alcohol helps muscular action (as was once supposed) or the reverse.

In this investigation the questions before us are :

(1) Whether the character of a neuro-muscular movement is altered by alcohol ?

(2) Whether the power of neuro-muscular movement is increased by alcohol ?

(3) Whether the active "tonic" state of a muscle is maintained when alcohol is taken ?

(4) Whether under alcohol the muscles grow and fully replace the wear and tear to which they are subjected ?

The ultimate answers to all these questions are in the negative, and are provided by a large number of practical experiments which have been made with regard to this intricate subject, and to which we shall now briefly refer.

1. **Is the character of a neuro-muscular movement altered by alcohol ?**

Such movements are what we term voluntary, and they depend for their proper execution on the active function of the "motor" cortex of the cerebrum associated with the function of the cerebellum. It might be supposed that a simple muscular movement consists of a single shortening of the muscle ; this is not the case. A nerve centre does not send out one single gush of energy, but a rapid intermittent stream of impulses. This was first discovered in the dog by the French investigators, Franck and Pitres, and since their original observations, other experimenters have found that cortical voluntary centres pour out a succession of shocks, as it were, to the muscle at the rate of about twelve per second. In man we can obtain a demonstration of this in precisely the same manner by voluntarily contracting the muscles of the thumb

and recording it by suitable physiological apparatus. If the nerve centres are becoming disorganised, this intermittent action will be exaggerated into tremor; hence it is of great interest, in studying the effect which alcohol produces on the brain, to find that this tremulousness in the performance of a voluntary act is an early and characteristic symptom, and the explanation of its occurrence is obvious.

The well-known shaky hand of the person who takes alcohol is the practical demonstration in social life of this fact. It is important to note that those who set up by their habits a chronic shakiness and tremor customarily take more alcohol to narcotise their nerve centres, and thus drown to some extent the exaggerated intermittency of their nerve currents. This they term "steadying" their hand.

2. **Does alcohol increase neuro-muscular action?**

Experiments of Dr. Parkes.—A series of observations made by the late Dr. Parkes of Netley, and reported by the late Sir Andrew Clark, bear upon this matter. A number of soldiers of the same age and the same type of constitution, living under the same circumstances and eating the same food, were collected together, and then divided into two gangs, an alcoholic gang and a non-alcoholic gang. Certain work was given them to do, for which they were paid extra by Dr. Parkes, according to the amount of work they accomplished. The men in the gang which was allowed alcohol had beer at their disposal, and when they felt

tired they resorted to its use. For the first hour or two the alcoholic gang went ahead, but after a time their energy began to flag, and before the end of the day their rivals, the non-alcoholic gang, had accomplished far more work, and received more pay. When this had gone on for some days, the men who were having beer begged that they might be transferred to the non-alcoholic gang, in order that they might earn more money. Dr. Parkes declined to allow this, but, in order to make the experiment conclusive, he transposed the gangs, the men being willing to lend themselves to the experiment. Those who had so far had beer were now allowed none at all, the others, who had so far been abstainers, being given the beer. The results were exactly the same. The alcoholic gang went ahead at the starting, but failed utterly towards the end of the day, the non-alcoholic gang now accomplishing far more work than the other.

Experience of Military Experts.—The majority of modern authorities on military matters in Europe and America now recognise that severe exertions can best be endured, either in cold or hot climates, without alcohol, and the men are therefore encouraged to be abstainers.

General Sir Francis Grenfell stated in 1896 :—

"The campaign in Egypt was a teetotal campaign. We drank the Nile and nothing added. I took over the rear-guard on the occasion of the finish of the campaign, and in no other part of the world have I seen a force of men so fit

and so well as that force which was employed upon the Nile."

Similar testimony is given by Count von Haeseler, late Commander of the Sixteenth Army Corps in Germany upon this point :—

"The soldier who abstains altogether is the best man. He can accomplish more, can march better, and is a better soldier than the man who drinks even moderately. Mentally and physically he is better. Brandy is the worst poison of all. Next to it comes beer. Each limits the capacity and lowers mind, body, and soul. Strong drink tires and only increases thirst. For soldiers, water, coffee, and above all, tea, are the best drinks."

During the Soudan campaign, as is well known, Lord Kitchener allowed his soldiers no spirits whatever, the men being encouraged to drink cold tea when upon long marches.

Lord Roberts has been equally firm in the matter of encouraging abstinence from alcohol, and so convinced are they in America of the superior vigour and energy and more reliable moral character of abstaining soldiers, even in times of peace, that in the new military law, promulgated in the United States, the sale of intoxicating liquors is forbidden in all canteens and on all territory that is used as a military field by the Government.

At a meeting of the Finnish Medical Society in 1884, the Surgeon-in-Chief of the Finnish Army, Dr. C. F. Wahlberg, said :—

"My experience as military surgeon has taught me that alcoholic liquids are unnecessary, and do not belong to human food-stuffs. During the war of 1877-8, those soldiers who did not indulge in their brandy rations endured their exertions much better than those who used them: old drinkers were the first to break down from exertion."

At present the soldiers in Finland are never allowed brandy, and very seldom beer.

In the recent war between England and the Transvaal the use of brandy and spirits was prohibited amongst the Boers, and the significance of this fact was discussed by Fr. van Straaten in an article sent to the *Deutsche Warte*, in which he says:—

"From these regulations we have obtained the best results. In all weather our people have sat in the saddle and travelled hundreds of miles with scarcely the loss of a single man. There were no uniforms manufactured according to the teaching of hygiene. Every one went clothed just as he would go about his work in time of peace. Many had not even one warm cloak, and yet we endured the fiery heat of the African day and the following piercing cold of the night without injury to health. We were often for months under no roof, and in no bed, but no "stomach warmer" was ever handed out.

"I have during the campaign asked various physicians their opinion on this point. They are almost universally of the opinion that the wonderful power of endurance of the Boer army has in great part been due to their total abstinence from spirituous drinks. Men say that brandy makes

privation more endurable. No word of that is true. It is also a fable that when one takes spirituous drinks it relieves fatigue. All that is true is that the drinker does not measure the extent of the danger, and on that account disdains it, even if he is cowardly by nature. In earlier times, when the method of fighting was to run down the antagonist by a wild dash, alcohol probably had its effect. But modern scientific warfare has other features to reckon with: tranquillity, cold-blooded deliberation, iron endurance, a steady hand, a clear eye, a quick decision, are the qualifications which the warrior of the present day must possess in order to make the rifle in his hand a formidable weapon. To remain hour after hour under cover, and coolly, with the sharpshooter's eye, wait the cautious approach of the enemy, or, in attack, to scan with falcon's eye every stone, every rise of ground, every molehill, in order, if possible, to come upon the enemy unperceived—that is business which requires actual courage, but not that drunken tumbling into danger with which one whose brain is clouded by the use of alcohol enters into a battle. The thing is not to under-estimate danger, but to recognise it, by foresight to diminish it, and, if that is not possible, to meet it coolly."

From the English side we have the following comment by Sir Frederick Treves:—

"As a work producer alcohol is exceedingly extravagant, and, like all other extravagant measures, leads to a physical bankruptcy. It is also curious that troops cannot work or march on alcohol. I was, as you know, with the relief column that moved on to Ladysmith, and, of course, it was an extremely trying time by reason of the hot weather. In that enormous column of 30,000, the first who dropped out were not the tall men, or the short men, or the big men, or

the little men—they were the drinkers, and they dropped out as clearly as if they had been labelled with a big letter on their backs."

The foregoing evidence is entirely confirmed by the practice of trained rowers, cricketers, sportsmen, and athletes, for the true sportsman depends as much upon the condition of his brain for success as upon the condition of his muscles alone. In England it is now recognised that total abstinence is a necessity where great exertions are concerned. For example, in 1892 the Great Western Railway decided to change the gauge along 200 miles of their system. It was needful to complete this work in two days. Every possible preparation was made, and five thousand skilled workmen were collected for the job, the huge task being accomplished in thirty-one hours. The managers, owing to previous experience, decided that not a drop of liquor should be permitted along the line of work, and they supplied instead good oatmeal and water, about ten tons of oatmeal being used.[1]

The following statement, furnished to Professor Hellenius by a gentleman at Uxbridge, has the advantage of being the comparative return of the regular labour of a whole year, performed by two sets of men, the one working on the "abstinent," and the other on the "moderate" system, but not pitted against each other in a contest for victory. It relates to brickmaking, which is commonly ac-

[1] *Abstinence and Work*, by Charles Wakely, London, 1893.

counted one of the most laborious of all out-door employments :—

Out of upwards of 23,000,000 of bricks made in 1841, by the largest maker in the neighbourhood, the average per man made by the beer drinkers in the season was 760,269; while that of the teetotallers was 795,400, which is 35,131 in favour of the latter. The highest number made by a beer drinker was 880,000; the highest number made by a teetotaller was 890,000, leaving 10,000 in favour of the teetotaller. The lowest number made by a beer drinker was 659,000; the lowest number made by a teetotaller was 746,000, leaving 87,000 in favour of the teetotaller. Satisfactory as the account appears, I believe it would have been much more so if the teetotallers could have obtained the whole gang of abstainers, as they were frequently hindered by the drinking of some of the gang; and when order is thus broken, the work cannot go on.[1]

Professor Hellenius was informed by Captain Pethrick, the manager of the copper-mines of Knockmahon,

. . . that more than 1000 persons are daily employed, of whom 800 have taken the total abstinence pledge. Since doing so, the value of their productive industry has increased by nearly £5000 sterling per annum; and not only are they able to put forth more exertion, but their work is done better and with less fatigue to themselves. Besides this they save at least £6000 sterling every year, which had previously been expended in the purchase of alcoholic liquors.[2]

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[1] *Die Alkoholfrage*: Hellenius. [2] *Ibid.*

Experiments with the Ergograph.—Various investigators have attempted to approach this problem by experiments with the ergograph, an instrument invented a few years ago in order to try and determine the amount of "work done" by certain muscles or groups of muscles. For instance, the middle finger is commonly used, being fitted with a ring of leather, to which is attached by a string a weight of about 9 lbs. hanging over a pulley. The forearm and hand being at rest, this one finger is bent at intervals of from one to two seconds, the weight being lifted as high as possible. The movements are registered and are kept up until exhaustion occurs.

The face-value of this method appears good, but when tested practically it is extremely difficult to avoid error of various sorts, because it is really not a test of the muscles alone, but to a large extent of the nervous system. In the hands of some observers a marked loss of muscular power is found to occur after the taking of small quantities of alcohol, in the hands of others the results have been more equivocal, this being accounted for by the fact that the personal equation with regard to the action of alcohol on the neuro-muscular system is a very variable one.

It evidently requires the performance of a large number of prolonged experiments before any evidence supplied by the ergograph can be accepted as approximately reliable, and even then they can never be

compared with the practical experiments upon large bodies of men, such as exist when armies are in the field or when railways are in course of construction. For as an ergograph experiment is only an observation upon one person, the personal element therefore figures largely, whereas in the experiments in the mass this factor is excluded.

Effect of Alcohol upon the Muscular Energy of Dogs.—This question, as to whether or no alcohol increases neuro-muscular action, has been investigated scientifically by Professor Hodge, who for this purpose employed four puppies as nearly alike as possible in age, size, etc.

To test their daily activity a form of pedometer was devised which could be fixed in the dogs' collars and read at corresponding times. After a period of preliminary testing, alcohol was given to two of the puppies in their food. Soon after beginning the administration of alcohol it was often noted that the normal dogs were playing actively, whilst the alcohol-taking dogs were quiet, and content to do nothing.

A test was then devised "that would elicit the comparative ability of the dogs as to strength, endurance, and resistance to fatigue," the dogs being taught to retrieve a ball when thrown. When it was desired to make such a trial, the dogs were all taken to the University gymnasium, and a rubber ball was thrown across the room, a distance of one hundred feet, as fast as it could be retrieved.

A record was kept of all the dogs that started for the ball and of the one that brought it back. One hundred balls constituted a test, and to throw them consumed about fifty minutes.

The first series consisted of 1400 balls, thrown on fourteen successive days in January 1896, the result being that the two normal or non-alcoholic dogs retrieved 922, the alcoholics only 478 balls.

Moreover, it was noted that the normal dogs made more attempts to retrieve the ball than did those taking alcohol, thus affording good evidence of their "greater alertness, strength, and energy."[1]

3. We have now briefly to answer the third of the questions before us, *i.e.*

Is the active "tonic" state of a muscle maintained when alcohol is taken?

The effect of alcohol on the tonic contraction of muscles is worthy of some notice. It must be understood that the muscles in a state of health, *i.e.* under the normal influence of the nervous system, are always in a state of tension (*e.g.* slight degree of contraction), this being spoken of as "the tonus."

This tonus is notably diminished by alcohol whether directly by its action on muscle or indirectly by its action on the nervous system is uncertain, but the practical bearing remains the same, namely, that all muscular movements are, in the absence of the natural

[1] *Physiological Aspects of the Liquor Problem*, vol. i. p. 369.

tonus, weaker and less correctly performed. The condition is, in fact, comparable to the loss of tone in muscles seen in persons who have passed through severe illness.

For the accurate and quick performance of skilled movements such as are required in violin-playing it is, of course, essential that this "tone" of the muscles should be at its best. It is a matter of common knowledge that abstinence from alcohol is essential for those who would use their mechanical skill to the greatest advantage, this being a matter of muscular control and training.

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4. To the fourth question before us, *i.e.* **whether under alcohol the muscles grow and replace their wear and tear?** the following reply may be given :—

The tissue of our muscles is, of course, always wearing out and being reformed or grown again, and, as is well known, this growth of the tissue leads to actual increase of the size of the muscles when they are specially exercised. Its occurrence, which is clearly of importance to our muscular activity, is hampered and prevented by alcohol. Instead of the muscles maintaining themselves in good condition, they become, under alcohol, flabby and less vigorous and effective. This is known to those who train for boat-racing and other athletic pursuits, and they therefore readily acquiesce in the stringent orders to avoid alcoholic drinks for the time being, their desire to keep in good

muscular condition causing them to abstain. It is worthy of note that those who avoid alcohol all the year round are permanently in a better muscular state, and do not require to go into such strict "training" for the races as those men who in the intervals take some alcohol.

This flabbiness and lack of muscular energy is a serious loss to the nation, because individuals who thus suffer from "a want of spring," accomplish less work than they are normally capable of, and, moreover, what they do is often badly done. In fact, alcohol is among all causes of physical depression pre-eminently responsible for the inertness and so-called idleness of many human beings, who might on the other hand become fairly capable and efficient citizens were they properly fed and not drugged.

A further phase of the ill-effects of alcohol on the muscular system is exhibited by the fatty metamorphosis undergone by the muscles (and tissues enveloping them) of those who habitually take alcohol.

We shall describe in Chapter XII. this fatty degeneration of the muscle, as it occurs in the muscular substance of the heart. In that case, of course, it is not only a further source of inertia and physical exhaustion by reason of its weakening the heart and lowering the blood pressure, but becomes a source of danger to life by leading to sudden cardiac failure.

To sum up: it is now beyond question that alcohol,

even in so-called dietetic quantities, diminishes the output of muscular work both in quantity and quality, and that the best physical results are obtained under total abstinence from its use.

Part IV. The Effect of Alcohol on the Cerebellum

Until recently the effect of alcohol on the cerebellum has not been specially studied, although the similarity between the reeling of cerebellar disease and alcoholic poisoning, respectively, has long been recognised. The cerebellum is a remarkable sensory organ which receives impressions from the trunk and limbs, and then transmits them from its nuclei to the cerebrum and indirectly to the spinal cord. It is thus in the position of a kind of regulating or sorting office, the duties of which are the co-ordination or systematic arrangement of sensations, which inform us as to our position in space, and consequently our power of standing upright, of walking steadily, and of balancing the whole body in different postures is wholly dependent on the healthy activity and function of the cerebellum.

It naturally follows that when the cerebellum is affected by such a narcotic as alcohol, there soon occurs loss of the essential regulation of control of the limbs and especially of the lower limbs, which feel heavy and no longer move with precision. As a consequence of this the ease of sitting still is preferred to

the effort of even standing or walking, and when obliged to stand the person staggers slightly in assuming the erect posture, and later on reels if he attempts to walk forward.

Before a small dose of alcohol has reached the point of causing tottering in the gait, it affects the more delicate movements of the upper limb, and it is for this reason that movements of sleight of hand and dexterity, or those involving delicate differences of pressure as in rifle-shooting, are only successfully performed when people abstain from alcohol, and thus leave the cerebellum unimpaired and able to work with complete efficiency.

The conditions requisite for rifle-shooting are very complex, necessitating that the muscles of the eye as well as those of the limbs should be under the complete control of the nervous system, in order that absolute accuracy of aim may take place.

Valuable evidence on this point was given in 1905,[1] when Staff-Surgeon Mernetsch set forth the facts and experiments made concerning the value or otherwise of alcohol if administered, for instance, before action in war. Sweden was the first country to put the question on a scientific basis. A number of picked soldiers and non-commissioned officers, all good shots, were told off for these experiments. They were ordered to shoot at a target at ordinary distance (200 yards), then they were given

[1] *Report of the International Anti-Alcohol Congress held at Buda-Pesth in 1905.*

each one-twentieth litre of brandy (equal to about $1\frac{1}{2}$ oz.). The trials were made on different days, under varying conditions, several times a day, and the result was always the same. When alcohol had been given the result was 30 per cent fewer hits in quick-fire, although the men always thought they were shooting faster, whereas actually they shot much more slowly. When slow aiming was allowed, the difference even went to 50 per cent in favour of shooting without having taken alcohol. The conclusions are obvious.

DEGENERATION AND DISEASE OF THE NERVOUS SYSTEM DUE TO ALCOHOL

"The vast increase of lunatics in this country demands the serious consideration of every means which can legitimately be used to protect society from physical and mental degeneration."—Sir Edward Fry (Lord Justice of Appeal), *Evidence given before the Royal Commission on the Care of the Feeble-Minded*, 1905.

"During the years 1861-5 there entered the asylums of France 14,983 insane persons. In the same space of time, twenty years later, there entered more than 57,000. . . . Dr. Serieux made researches, and found that of the relapsed cases 78 per cent were drinkers, while of violent lunatics 88 per cent were drinkers."

". . . We have too big a beam in our own eye to moralise on the state of France."—*The Lancet*, May 1889.

"Alcoholic insanity steadily goes up. This year no less than 42·3 per cent of all our men and 18 per cent of our women—much the largest proportion we have ever had experience of—had excess in alcohol assigned as the cause of their insanity. In the five years, 1873-7, the percentage of alcohol cases was only 18·5 among the men, and 10·4 among the women admissions. It has steadily gone up, and now it has doubled. No explanation will account for this but the one that certain classes of our population are drinking to greater excess than they did, and in doing so are, many of them, destroying their sanity."—Dr. Clouston. *Report of the Morningside Asylum*, 1903.

"It is certain that for every man in whom excessive drinking causes absolute insanity there are twenty in whom it injures the brain, blunts the moral sense, and lessens the capacity for work in lesser degrees."

"It is most sad and discouraging that this preventable cause of the most terrible of all human diseases should thus continue to increase. It is a veritable plague spot in our social life."—*Ibid.*

CHAPTER VI

DEGENERATION AND DISEASE OF THE NERVOUS SYSTEM DUE TO ALCOHOL

No account of the effect of alcohol upon the nervous system is at all adequate unless allusion be made to the profound and too often permanent mental deterioration and instability which it induces, as a result of its depressing action upon the brain and spinal cord. By the general public little is, of course, known with regard to this painful subject, for the patients, although numerous, are, as far as possible, hidden away in private homes or asylums, and those of us who are at work in the world outside contrive to protect our own happiness by thinking little about the thousands of lonely and wretched men and women who inhabit these institutions: in fact, the doctors who manage them are practically the only people who at all realise the ghastly waste of life and happiness that alcoholism entails.

The craving for alcohol, which leads to final disaster in the shape of social and intellectual downfall, may be either periodic or chronic.

Dipsomania is the general expression used to describe a condition of recurrent uncontrollable craving for alcohol. The attacks occur more or less periodically at intervals from six weeks to a year, in persons who at other times are perfectly free from the drink crave. Quite early in adult life these exhibit a tendency to drink to excess, and no consideration of disgrace or loss of income or of social standing can finally deter them. After ineffectual struggles the barriers of self-control break down, often towards night or during the night; alcohol in some form is taken copiously, and the patient may then drink straight on, or be continuously drunk for a week or a fortnight, the outbreak often culminating in an attack of delirium tremens. Even when the sufferer takes precautions against himself, and provides, by entering an asylum, that his craving shall not be indulged, the suffering during the attack and the subsequent prostration may be marked.

Insanity and Alcoholism

If a man, day by day, pours such an amount of alcohol into his blood that morbid stimulation and irritation of his brain cells results, that man is in danger either of actual insanity or of degenerative mental changes allied thereto. Only during recent years have scientific workers been able to point out and satisfactorily explain the intimate relationship that exists between insanity and intemperance, and to-day the interdependence of these two conditions one upon

the other still needs and is receiving careful investigation.

The average number of cases of lunacy annually admitted into the asylums of England and Wales is 10,445 males and 10,852 females.[1] Of these annual admissions, ascertained personal intemperance in drink is stated by the Commissioners in Lunacy to be responsible for 22·5 per cent of the male cases and 9·2 per cent of the female cases.

Now these percentages do not include those cases in which the break-down may be more or less traceable to alcoholism in the parents of the patients, nor do they include those cases in which it has been one factor out of several, and a factor about which accurate information is liable to be held back by the patient and his friends.

Where these elements in the causation are counted it is considered, generally speaking, that alcohol is accountable for fully 20 per cent of the cases under care in our asylums.

With regard to the number of cases under detention at any one time for this preventible mental condition, Dr. Robert Jones has shown[2] that out of the 116,000 cases of insanity detained in 1904 in our asylums, probably no less then 11,000 males and 6000 females owed their illness directly or indirectly to drink.

And we must remember that large numbers of

[1] See *Report of Commissioners in Lunacy*, issued September 1906.
[2] *British Journal of Inebriety*, July 1904.

these patients are of an age when they should be active members of the community, instead of being the cause of much of the broken home-life and child misery which is our special disgrace as a nation, as well as being the occasion of much needless expense to the State.

In Ireland matters are little better. The Census Commissioners show that whereas in 1851 there was one lunatic in every 657 of the population, in 1901 there was one lunatic in every 178 of the population.

The exact part played by alcohol, as one of several causes which has led to this untoward state of things, has yet to be determined, but the following facts are significant:—

The counties of Ireland have been arranged according to their "Drunkenness rate," *i.e.* the proportion of recorded cases of drunkenness to their population for the average of the years 1899-1903. In this list the county of Waterford stands first, one drunken person in every 28·5 of population being the proportion recorded.

This same county heads the list of counties arranged according to their "Lunacy Rate," one in every 104 of the population being a lunatic.[1]

The report of the Waterford Lunatic Asylum for 1903, states that "the most frequent cause of the insanity of those admitted was intemperance":

[1] "The Relation in Ireland between Lunacy and Drunkenness," by W. Macvey. *Medical Temperance Review*, December 1906.

—and on studying the records we find that 23 per cent of the cases admitted that year were attributed to alcohol, whereas in the same year hereditary predisposition was the cause of 16·2 per cent of the admissions. On taking the averages for this institution during three years (1903, 1904, 1905), hereditary predisposition accounts for 17·6 per cent of the admissions and alcohol for 19·6 per cent.

All these sets of figures, it must be remembered, represent only those patients who were ill enough to merit asylum treatment, and do not, of course, include the very large number of cases of delirium tremens, epilepsy, and other conditions caused by alcohol, which occurred in that same year, but were treated for various reasons in their own homes, or in general hospitals and infirmaries.

Alcoholic Insanity

As Dr. Maudesley well points out :—

"A drunken man notably exhibits the abstract and brief chronicle of insanity, going through its successive phases in a short space of time. First, a brisk flow of ideas, inflamed emotions, excited talk and action, aggressive address, unusual self-confidence, a condition of stimulated energy with weakened self-control, so like the sort of mental excitement which goes before an outbreak of mania that the one is sometimes mistaken for the other; next, as in insanity, sensory and motor troubles, incoherent ideas and conversation, and increasing passion, which, according to the previous

temperament, is expansive, quarrelsome, melancholic, or maudlin, and which may sometimes, as in insanity owning no cause, go through these stages in succession in the same individual; lastly, a state of stupidity or stupor, which might be called, and is, essentially a temporary dementia." [1]

Cases of "alcoholic insanity" pure and simple may be divided into three main groups:—

1. **Acute alcoholic mania.**
2. **Delirium tremens.**
3. **Chronic alcoholic dementia** (including alcoholic delusional insanity).

Each of these three groups constitutes a definite clinical picture. In the first two, the alcohol acts as a powerful irritant to the brain cells of the motor centres, and the result shows itself in muscular excitement and violent uncontrolled movements, which often go on for days, and may even require the use of a padded room. This wild delirium is characterised by hallucinations both of hearing and of sight. The patient hears voices, which seem so clear and audible, that they often incite him to definite action, destructive or otherwise. The illusions of sight are frequently so extreme that the figures of well-known friends are not recognised, but are often thought to represent "fiends"; while a simple shadow under a bed may arouse an insane suspicion which it is impossible for the attendants to dispel. All such delusions of suspicion render the patient a source of serious danger to others.

[1] Henry Maudesley, M.D., *Pathology of Mind.*

1. **Acute Alcoholic Mania.**—In these cases of alcoholism the symptoms of drunkenness, instead of merely following the more usual form of quarrelsomeness or savage conduct, develop into furious mania, and as a frequent consequence the patient requires admission into an asylum. It is unnecessary to enter into a detailed description of this condition; it suffices to say that the whole brain is in a turmoil, and completely paralysed as regards all its normal powers of action and understanding. The patients are usually men in the prime of life, and the outbreak often follows a single recognised excess in the use of alcohol. "Recovery" is a slow process, in fact, a long time may elapse before a brain so violently disordered regains its equilibrium.

Frequently on again resorting to alcohol these cases have a "relapse," and require re-admission to an asylum, thus again becoming a misery to themselves and an expense to the State or their friends.

Dr. Mott has shown that—

"A large proportion of the recoverable cases admitted to the London County Asylums consists of pure drink cases, and of these 50 per cent are discharged within three weeks to six months of admission. They often return again in a short time, and some cases, termed "recurrent mania" and "recurrent melancholia," are discharged and re-admitted many times, thus fictitiously raising the recovery rate. Many of these people would not come to the asylum were they not subject to the temptation of drink, for which they have an inborn or acquired intolerance."[1]

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[1] *Alcohol and Insanity*, by F. W. Mott, M.D., F.R.S.

2. **Delirium tremens** occurs as the result of repeated debauch. The feeling of elevation that the inebriate experiences is sometimes present in the first attack, but when these become repeated it is the headache, the sleeplessness, the distorted vision, and the sense of acute misery and impending disaster that predominate, and that obviously outbalance any so-called "jollity" that alcohol may have seemed originally to provide.

Before this delirium actually occurs, the profound depression under which the nervous system is labouring may be seen in the nightmares and the gloominess and timidity of the patient, in his inability to think or to make simple decisions, in the tremor of his muscles, in his shivering, his vomiting, and weakened heart action. The hallucinatory condition is due to the fact that the sense centres of the cerebrum are suffering from constant perverted stimulation, and consequently their action is entirely faulty. Thus a tiny spot on the wall is thought to be a creeping beetle, ordinary shades and shadows in a room are interpreted by the brain as ghosts and evil beasts, and the faces of friends seem one weird array of mocking demons.

Moreover, the higher centres of the brain associated with the manifestation of judgment, reason, and decision are also poisoned, and hence the "pluck" which an ordinary man would exhibit is wanting, and the wretched patient cowers and cringes before terrors that are merely the fabrication of his wrongly acting

brain. The motor centres are similarly upset, so that the wildly excited and temporarily insane person struggles with tremulous weakness against those who control him. In this state the heart and respiration may collapse.

3. **Chronic alcoholic dementia** is a condition that usually comes on slowly as a result of repeated indulgence in spirit drinking. We have already described (under the heading of Subacute Alcoholism, p. 82) some of the early signs which accompany the onset of this condition of dementia, especially the mental deterioration which shows itself in lack of ability to comprehend and deal with the facts of life in a sensible way. Frequently it is this mental inability which accounts for the failure on the part of the patient to appreciate rightly his own condition, thereby leading him to disregard advice which might have saved him from further drifting into alcoholism.

After a certain time the habitual use of alcohol is liable to cause a kind of perpetual excitement of the nerve centres, due to a severe chronic alcoholic "inflammation" of the brain known as cerebritis. This excitement is shown to the outside world by a restlessness and irritability of body and mind. The habitual drinker is easily offended, is subject to insane delusions, and is very suspicious and jealous. A passing phase of alcoholic jealousy often leads to unfounded allegations being made against others. For instance, not infrequently a wife is made to suffer great mental distress on account of false charges

circulated by a husband who, when sober, fails even to remember that he said anything unusual. Jealous mania is responsible for quite a number of the crimes of drinkers in whom outbreaks of anger, followed by periods of depression, are frequent and violent, and occur without sufficient motive.

These emotional outbursts, due to the loss of higher intellectual control, may for some time be the chief signs of mental obliquity. They are accompanied by muscular weakness and digestive derangements. Slowly and insidiously the symptoms of premature senility of mind appear. One of the most commonly observed alterations occurs in connection with the moral sense; the drinker's conscience soon becomes blunted, he becomes morally indifferent; an anti-social feeling is developed; his affections disappear, and, as a consequence, he keeps away from his family. Often the increasing demoralisation shows itself in selfish, brutish, and indecent acts, and he becomes a source of great anxiety to his friends. Regarding the purely intellectual faculties, a parallel downfall takes place. Judgment becomes more impaired, memory becomes more slow and uncertain, and imagination most deceptive. If the individual in this condition undergoes treatment, his mental vigour and his moral sense may to a considerable extent be gradually restored, but unless abstinence is carried out, a progressive weakening and disappearance of the faculties occur, he becomes increasingly weak-minded, vacant, and listless, and finally reaches a stage of

dementia, in which condition of mental ruin it is not possible to recognise his original character.

Alcoholic dementia, as compared with other forms of dementia, has a greater tendency to terminate rapidly in death. This is not surprising, seeing that alcohol affects every region of the body, including the large abdominal and thoracic organs.

Coincidently with this disorganisation of the mental powers, there exist both sensory and motor failure.

"In regard to the skin there are false sensations, pricking and itching, which the patient compared to the sensation produced by thousands of ants creeping over the skin (formication). These false sensations, exaggerated like all alcoholic pseudæsthesiæ during the night and by the warmth of the bed, affect chiefly the lower limbs. They are very troublesome, last a long time, and are apt to cause insomnia. They are precursors of more serious symptoms, and indicate that material lesions are commencing in the nervous centres. . . . The sensory derangements involve also the special senses, especially that of sight. Illusions of this sense are frequent. Acuteness of vision is also weakened; the use of the eyes becomes fatiguing, and objects become confused (alcoholic amblyopia).

Motor derangements are very characteristic. The most frequent is tremor. . . . The muscular excitability sometimes shows itself by more lasting and extremely painful contractions of the whole of certain muscles (cramps); they are especially noticeable in the lower limbs, in the calves of the legs, and occur preferably by night."[1]

---

[1] *Dictionary of Psychological Medicine*, art. on "Chronic Alcoholism," by Dr. Legrain.

Association between Melancholia and Alcoholism.—Unfortunately the foregoing large groups of insanity do not by any means include all the cases of mental illness in which alcohol plays a part. In addition, there are to be found in our lunatic asylums large numbers of patients whose break-down is due to several contributory causes, one of these being alcohol.

"The blood is liable to be poisoned by all sorts of things, from bacteria to alcohol," and it is easy to see that several of these poisons may act hand in hand and reinforce one another. Moreover, an unstable nervous system is often a factor of importance, which, when associated with such conditions as overwork and alcohol, may result in a downfall.

It is characteristic of the derangements of intellect caused by alcohol that they are of a painful nature, and it is therefore not surprising that, in the case of an already exhausted brain, the taking of this drug should increase any latent tendency to melancholia that may exist, or should even bring on an attack.

"Undoubtedly in alcoholic depression we see exhibited to the full its power to cause prolonged poverty of action of the nervous system, in consequence of which all thoughts are sad, and all actions seem to require a great effort before they can be accomplished." With regard to melancholia, it is well to remember that no mere bodily diseases can compare with the indescribable feelings of hopelessness and misery that are the lot of those suffering

from serious depression; and that, as compared with the other insanities, a melancholic patient is acutely conscious of his feelings, and thus is often more wretched than the sufferers from some other forms of mental break-down.

Temporary Outbreaks of Mental Unsoundness.—On this subject, which is one upon which the community is absurdly indifferent, we prefer to quote a London alienist of experience:—

"In addition to the actual numbers who are sufficiently poisoned by alcohol to be certified as insane, there are large numbers of individuals who are from time to time dangerously unsound, it may be for a few hours or a few days, who are the terror of their relatives, form a large proportion of the cases at police-courts, and ruin themselves in health and fortune. And those who have had charge of the insane will agree with me that the cases of mental disorder due to alcohol are among the most difficult to manage, the most hostile and litigious, and after recovery very often the most ungrateful of any patients with whom we have to do. No doubt in many cases the alcoholic is a person who starts life with an unstable nervous system; he has either alcoholic or insane or neurotic inheritance, and to a certain extent he is defective *ab initio* in self-control, and goes without much resistance into the paths of chronic alcoholism, but at present the Legislature has given him no assistance. The facilities for drinking are enormous." [1]

Loss of Memory.—Sometimes the depressive effect

[1] Percy Smith, M.D., F.R.C.P., Presidential Address before the Section of Psychology of the British Medical Association, 1900.

of alcohol acts specially on certain functions, such as the power of memory, persons who use large amounts of spirits being liable to curious brain-conditions (such as exist in epileptics), during which actions and crimes are committed of which the agent has not the slightest recollection. Side by side with this only recently recognised brain-state we may place those everyday lapses of memory in the chronic alcoholic which are the cause of so much perplexity to his friends. The condition termed "paramnesia," *i.e.* a failure of memory for recent events, is especially characteristic of alcohol poisoning. Not only is there forgetfulness of recent occurrences, but imaginary or long past events seem to take their place, and so confused and "lost" does the person become that his statements are absolutely contradictory. This failure of memory leads alike to forgetfulness of promises and of duties. The sense of time and space are lost, and there is an inability to distinguish between past and present. From a brain so poisoned that its functions are in this state of confusion it is useless to expect the least accuracy of statement; in fact, it may be almost predicated beforehand that the truth will be distorted.

Alcohol and Hysteria.—To an alcoholic taint in parents or grandparents may often be traced the condition known as hysteria, in which the miserable possessor of an unstable nervous system evinces all varieties of nerve storms and explosions, in a way

unaccountable to both himself and his friends. A further cause of this lack of nerve control may be found in the personal habits of the patient with regard to alcohol, the power of which to induce abnormal psychic conditions in certain persons being very marked, especially when these latter already suffer from the handicap of an imperfect heredity of one kind or another.

Alcohol and Epilepsy. — The disease known as epilepsy is characterised by convulsive seizures, which are due to varying forms of brain excitation. Consequently it is produced by different causes. Thus certain drugs, especially absinthe and alcohol, are particularly excitants of the cerebral cortex, and produce epileptic fits. Some individuals who possess congenitally an unstable brain exhibit a marked intolerance of alcohol, which causes them to have convulsive seizures on taking even small doses of this drug. Tanzi[1] alluded to such cases, and according to him all epileptics have their disease intensified by taking alcohol. Chronic alcoholic patients frequently become epileptic. Nor is this to be wondered at.

When we remember how many persons are born into the world with more or less cerebral deficiency, it is not surprising that the irritant action of alcohol should serve as a final factor in disturbing the government of the "motor" centres, and thereby bring on muscular movements of an abnormal and uncon-

[1] *Trattato delle malattie neutrali.*

trolled type (convulsions), accompanied by loss of consciousness.

This is forcibly pointed out by Dr. Mott, who says:

"Alcohol, even in comparatively small quantities, may convert the potential lunatic into a raving maniac, and it is specially dangerous to the epileptic and feeble-minded, leading in the former to the production of motor and mental fits, and making him irresponsible and anti-social and sometimes very dangerous to himself and others. . . . The quantity of alcohol which is daily consumed by the pillars of society is quite sufficient to convert an epileptic or potential lunatic, or certain feeble-minded individuals, into criminals or certifiable lunatics." [1]

Convulsive Attacks in Children. — These undoubtedly are often more or less directly connected with alcohol, as just explained.

Later on we shall draw attention to the occurrence of convulsions in breast-fed infants whose mothers take alcohol, and to the cessation of these attacks when the mothers are persuaded to abstain.

Sunstroke.—The fact that sunstroke attacks alcohol-takers rather than total abstainers is well known. It is, however, so striking an example of the disadvantage to the circulation of the brain caused by moderate drinking, that some consideration of the facts may be in place here.

Dr. W. R. Phillips,[2] of Washington, records 841

[1] *Alcohol and Insanity*, 1906.

[2] "Meteorological Conditions of Sunstroke," Dr. W. R. Phillips, *International Medical Magazine*, August 1897.

cases of sunstroke. Nothing was known of the personal habits regarding the use of alcohol in 376 of the cases. Of the remaining 465, the following were the facts :—

Alcohol was used to excess by	.	140 (or 30 per cent).
„ „ „ moderately by	.	230 („ 50 „).
„ „ not used at all by	.	95 („ 20 „).

Death resulted in 140 of the 841 cases ; and in the 70 about whom facts could be learned, these were as follows :—

Excessive indulgers in alcohol	.	41 (or 60 per cent).
Moderate „ „	.	22 („ 30 „).
Total abstainers . . .	.	7 („ 10 „).

In the Swedish investigation already alluded to (p. 141), the effect of alcohol on the men when marching could be studied during the manœuvres. Some companies were given small quantities of alcohol : others were kept without. It was clearly shown that drinking predisposed to sunstroke, indeed heatstroke was noticed only amongst the "drinking" companies. Since these facts have been ascertained, the Austrian soldier is not allowed to carry brandy when on march, except during severe winter weather and in the baggage of the ambulance corps.

The Influence of Alcohol on the Nerves of the Body

Passing from the diseases of the central nervous system caused by alcohol, we must now describe its

influence upon the peripheral nerves of the body, *i.e.* those rising in the trunk and limbs. These often suffer in conjunction with the brain, whilst at other times the chief force of the alcohol seems to be directed against the nerves and spinal cord, rather than the central nervous system.

Neuritis (Alcoholic Neuritis)

This is a painful neuralgic affection of the nerves of the body, often accompanied by loss of power in the limbs—especially in the legs. Frequently the pains are thought by the patient to be rheumatic, whereas in reality they are due to an inflamed state of the sheaths of the nerves, which inflammation rapidly begins to subside as soon as the taking of alcohol is stopped.

Young people and people in middle age are much more commonly affected with this alcoholic form of paralysis than are old people, and for various reasons this condition is more common in women than in men. Frequently the friends of the patient have no idea of the true nature of this very common complaint, and sometimes even the medical attendant fails to suspect the cause of the illness, until the pains (often very severe) have existed for some time and the loss of power has become marked. Occasionally the taking of alcohol medicinally (as it used to be given in a prolonged illness like typhoid) leads to this disorder, which requires total abstinence as the first factor in its

cure. But in this matter of cure it is not merely a question of a few days or weeks being required in order to get rid of the poison: prolonged abstinence and suitable treatment are really essential so that the damaged structures may become repaired and resuscitated and rendered fit for their work.

Alcoholic paralysis is the general term for a more pronounced degree of the same condition.

Structural Degeneration and Disease, Changes in the Nervous System caused by Alcohol

At this stage it is necessary that we should present the evidence that alcohol not only causes the severe disorders of nerve function just described, but definitely injures the structure of the nervous system. The microscope shows that grave alterations take place in the protoplasm of both the nerve-cell and fibre, under the action of alcohol, after this has been freely taken for some time. With regard to smaller doses, or to sudden intoxication in persons unaccustomed to alcohol, the findings of the microscope are naturally not so definite. But this is in no way surprising, for the function of the cells of the body is gravely disturbed by drugs long before these latter can alter the physical nature of the cell protoplasm so definitely that changes can be detected by the present methods of fixing and staining and the best means of microscopical investigation now known.

The chemical processes of the body are so complex that it requires extremely little to upset the balance. In the case of people who suffer from gout, certain individuals will tell you perfectly truly that if they take a small quantity of a particular kind of alcoholic drink, champagne, for example, it will invariably produce an attack, whereas they can take another kind of alcohol with apparent impunity. This shows, of course, that the chemical processes in their bodies may be upset by an astonishingly small quantity of the chemical reagent, and the effect, therefore, of so small a quantity of alcohol as suffices, for instance, to influence the rapidity with which the nerve corpuscle is able to subserve the process of thought, could not possibly be expected to be demonstrable by any appreciable structural alteration.

So, too, the chemical processes in the body are so delicate that an infinitesimal dose of poison (snake poison, for instance) can fatally arrest them without causing any changes of structure in the corpuscles which even the highest microscopical magnification can detect.

The changes wrought by chronic alcoholism, we shall see directly, are those of disorganisation of the actual particles of the cells themselves.

The explanation of these profound structural changes appears to be that alcohol is a powerful protoplasmic poison, having a special selective affinity for the delicate cells of the nervous system, with whose function and capacity it interferes even at a very early stage, finally causing permanent gross alterations in the tissue, which are demonstrable to both the naked eye and through the microscope. We are indebted to Dr. Mott for the

PLATE V.

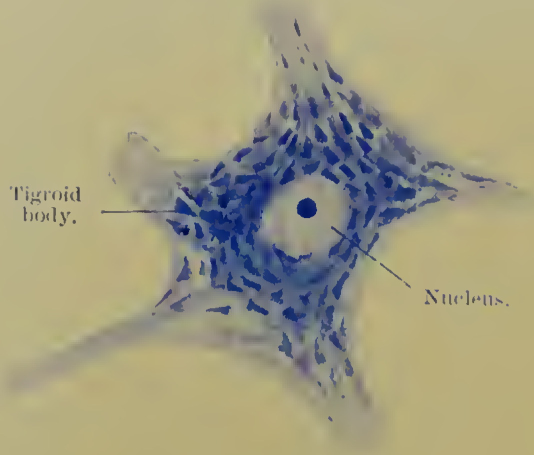


FIG. 1.

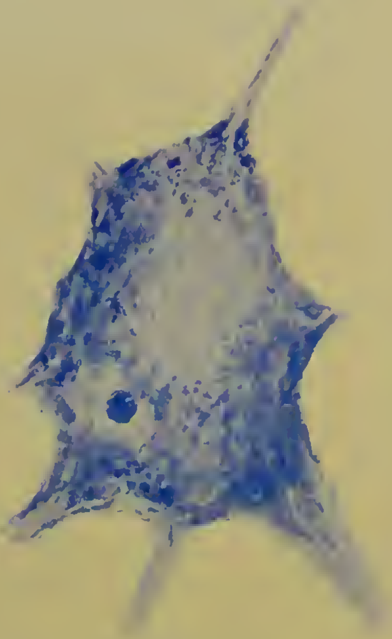


FIG. 2.

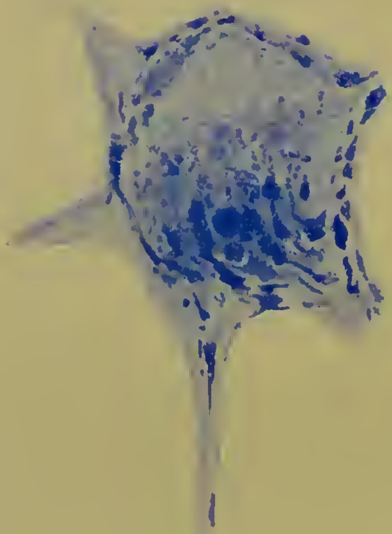
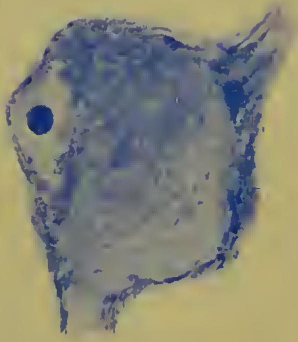


FIG. 3.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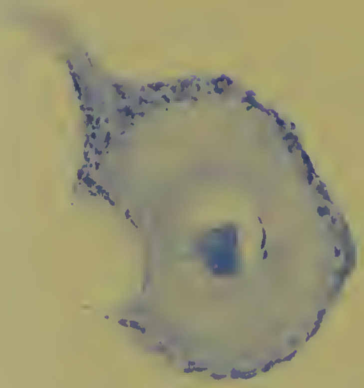
FIG. 5.

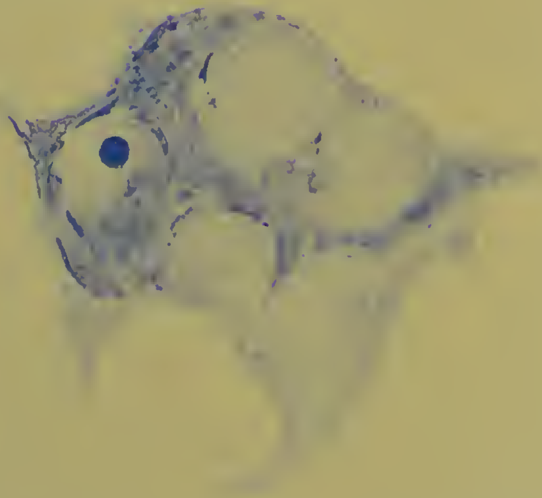
FIG. 6.

I. M. Kelley, del.

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PLATE V

In this drawing nerve cells or corpuscles (magnified 750 diameters) are shown stained with methylene blue to reveal their structure and the degenerative changes produced in them by alcohol. 1, is a normal cell. 2, shows the disappearance of the colouring matter, and that the nucleus is passing from the centre to the side of the cell. 3, 4, 5, and 6, show varying degrees of the breaking up of the corpuscles.

accompanying drawings, which illustrate this part of our subject. Those representing damaged tissue are taken from cases which died at Claybury Asylum.

Plate V., Fig. 1, shows a normal cell from the spinal cord, with its central nucleus and other parts, as described in Chapter IV.

Plate V., Figs. 2, 3, 4, 5, 6, represent the degenerative changes through which a nerve-cell passes, and each cell may well be compared with the normal, Fig. 1. The diseased cell becomes swollen (Figs. 2, 6), the nucleus gradually is pushed from the centre towards the margin; the spindle-shaped bodies swell up, and their outline becomes indistinct, and they gradually lose the power of taking on stains, the processes shrivel and disappear, empty spaces occur in the protoplasm (see 6), and finally the cell ceases to stain and cannot be seen.

A cell damaged in this way never recovers, and so far as we know is never replaced. Even the most casual observer can see the difference between the beautiful normal cell with its central nucleus and vigorous processes, and the swollen deteriorated cells taken from the spinal cord of the patient who died after a lingering and painful illness brought on by alcohol. The general effect when large numbers of cells are grouped together may be studied in Plate VI.

Next, as regards the effect of alcohol on the brain itself. Plate VI. represents a small portion of normal

brain tissue taken from the "motor" area of the cerebral hemisphere. It shows a large number of cells of proper shape and size, whose protoplasm stains well, the depth of staining being partly a measure of their vitality. With this must be compared Fig. 2, which represents the same part of the brain in a case of chronic alcoholic dementia, and shows:—

(1) A diminution of the number of cells.

(2) Their disintegration as indicated by their imperfect staining and irregular outline.

(3) An increase of the tiny supporting (glia) cells, which take the place of the real nerve-cells, and are perhaps of no value as regards mental action.

It is, of course, useless to expect mental integrity or ordinary sense to emanate from a brain in such a condition. Moreover, even the mechanical muscular movements can scarcely be performed, the patient sitting in an inert heap and requiring attendance as if he were a little child.

Plate VII. shows a group of degenerated spinal ganglion cells from a case of alcoholic neuritis and paralysis, in which the patient suffered from marked sensory disturbances, anæsthesia, and pain. Notice the shrinkage of the cells, the crumbling appearance of their edges, and the marginal position of the nucleus. As the cells degenerate, shrink, and disappear, their place is taken, to a considerable extent, by the supporting connective tissue of the

PLATE VI

Fig. 1

Vertical section of the grey surface or cortex of the cerebrum; from the "motor" area of a normal human brain. The nerve corpuscles are of all sizes, from the large cell marked "giant" to the very small ones near the surface. The wavy thin line at the top of the drawing is the free surface of the hemisphere covered with the thin arachnoid—pia mater membrane. The whole depth of the figure represents the depth of the cortex, which in its natural size amounts to about $\frac{1}{8}$th of an inch. It must be understood that the same cortex is pervaded throughout by fibres, which not being stained like the nerve corpuscles are not shown. These fibres convey nerve impulses to and from the nerve corpuscles.

Fig. 2

Section of the "motor" cortex of chronic alcoholic dementia to contrast with the normal brain section in Fig. 1. The nerve cells are extraordinarily reduced in number, having degenerated and wasted away. Of those that remain very few exhibit a normal outline. The large majority are shrunken and hopelessly damaged. Further, the glia cells, as displayed by their dot-like nuclei, are greatly increased.

Normal.

Fig. 1.

Alcoholic.

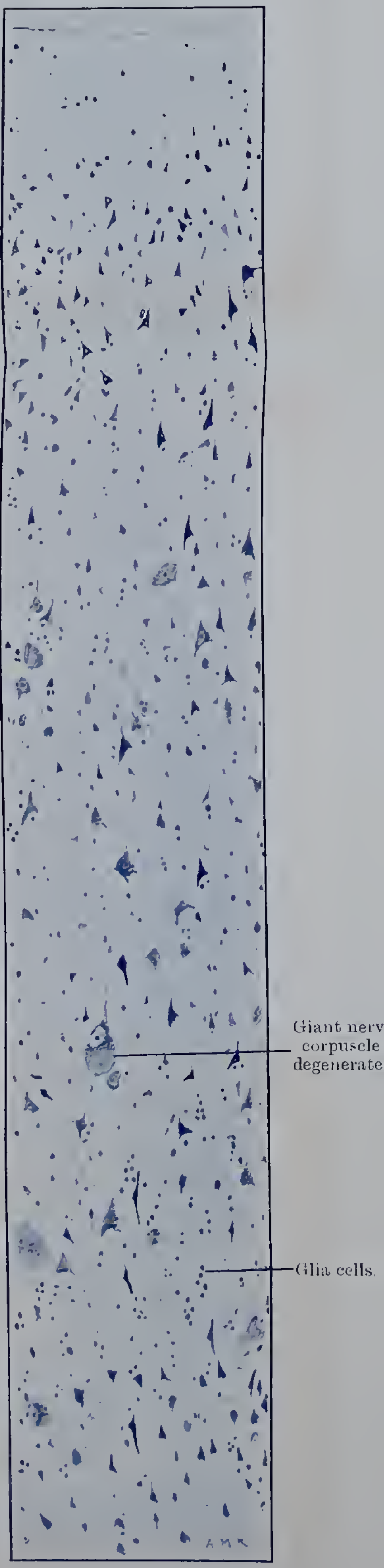

Fig. 2.

M. Kelsey, del.

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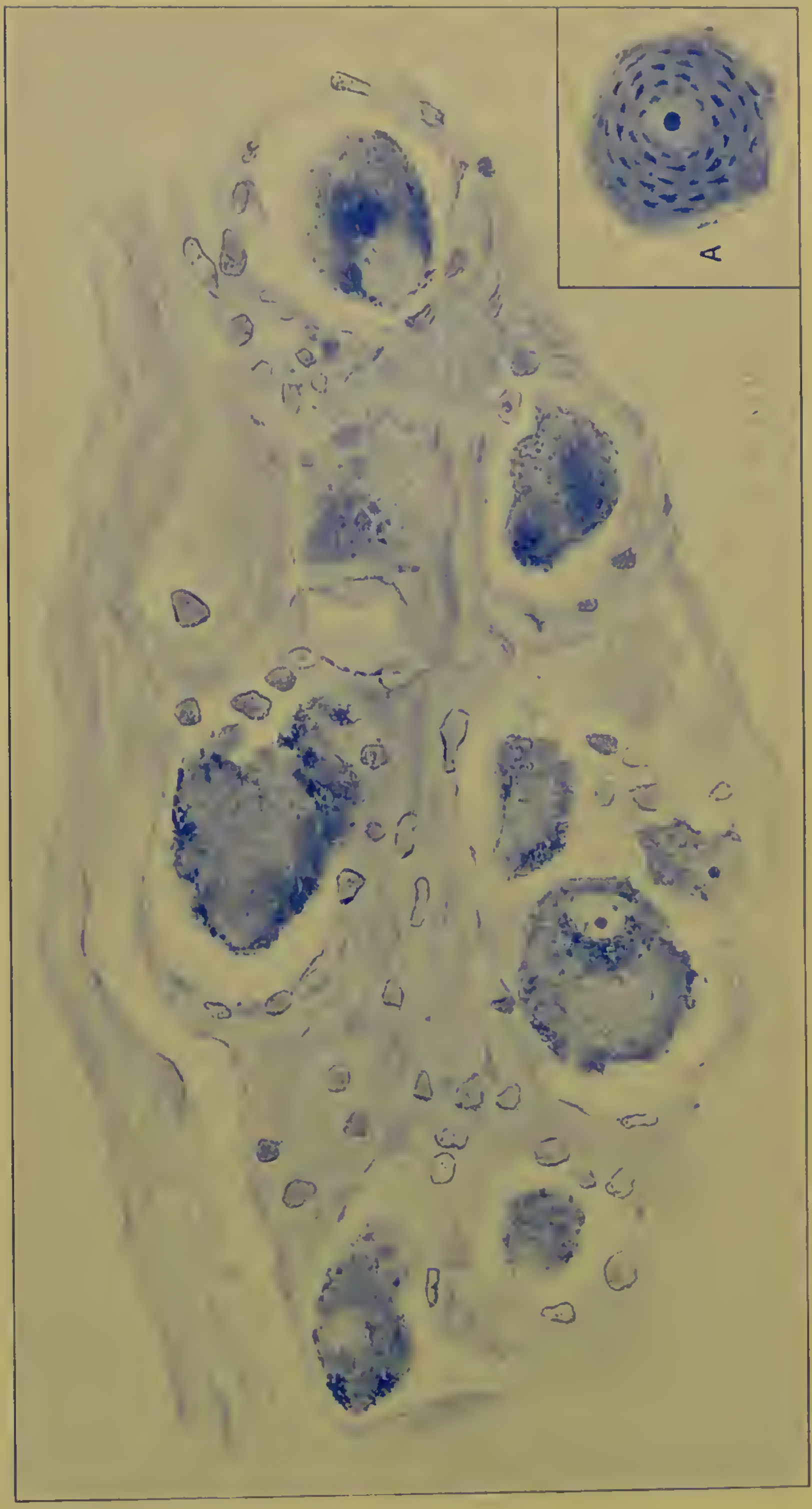
PLATE VII.



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A. M. Kelley, del.

o face p. 167.

PLATE VII

The nerve cells (magnified 375 diameters) in a (sympathetic) ganglion from a case of alcoholic paralysis. A normal corpuscle is shown at A in the corner square. Observe the shrunken, crumbling appearance of the alcoholised cells. In only two does anything resembling a complete nucleus remain, and in each of these it has moved to the side of the cell.

nervous system, which (as just shown) has no direct functional value and may be compared to the cotton wool in which jewels are packed.

Fig. 11 shows the normal depth of the covering membrane of the brain (pia mater) and the normal number of tangential fibres, with a few tiny packing cells in between. Compare this with Fig. 12, from a case of alcoholic dementia showing :—

(1) Marked thickening of the covering membrane.

(2) A space beneath this which is due to shrinkage of the brain substance and in which fluid tends to collect.

(3) A decrease in the tangential fibres, the real nervous elements, with a corresponding increase of the supporting ("glia") cells.

Fig. 13*a* shows normal nerve fibres, each of which consists of a delicate strand of protoplasm covered with a sheath.

With this compare Fig. 13*b*, which shows nerve fibres that have undergone degenerative changes due to alcohol. These consist in alteration of the sheaths, so that when stained black by suitable reagents the continuity of the (insulating?) material of the sheath is found to be broken and the substance collected in droplets.

We may sum up, then, the chronic changes produced by alcohol on the nervous system as follows :—In the first place there is a degeneration and ultimate destruction of the nerve-

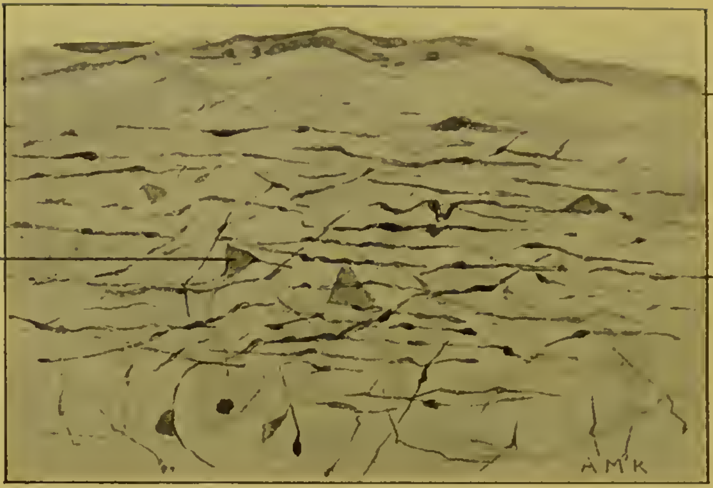


FIG. 11.—Microscopic section of the superficial layer of the cortex of the cerebrum (magnified 310 diameters), from a normal brain, showing healthy membrane (arachnoid and pia mater) and the normal number of fine tangential fibres.

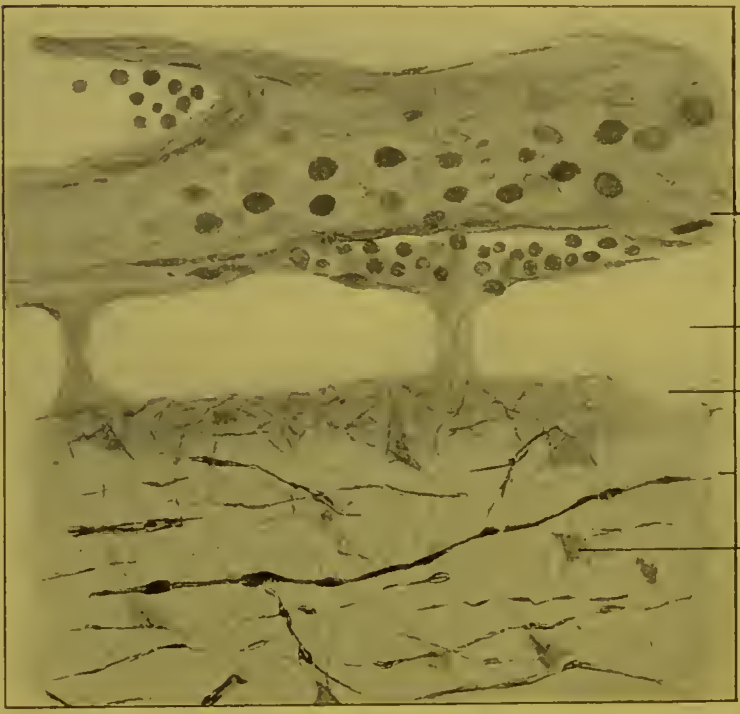


FIG. 12.—Microscopic section to contrast with Fig. 11 of the superficial layer of the cortex of the cerebrum (magnified 310 diameters), from a case of chronic alcoholic dementia, showing excessive (inflammatory) thickening of the membranes and also increase of the glia cells and tissue, with a corresponding loss (from wasting) of the tangential fibres.

cells and their processes. In the second place there is an increase in the supporting tissue which replaces the nerve-cells, and which is entirely useless from the point of view of nerve action. This is merely another example of the increase which occurs in the supporting connective tissue

FIG. 13*a*.—Normal nerve fibres moderately magnified. Compare with Fig. 13*b* in which fibres degenerated by alcohol are shown.

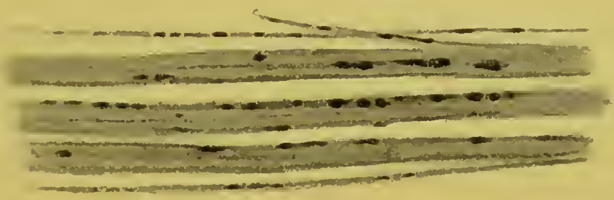


FIG. 13*b*.—Nerve fibres degenerated by alcohol from a patient suffering with neuritis. These fibres have been prepared and stained in the same way as those in Fig. 13*a*. The fatty sheaths of the fibres (stained black) are seen to be broken up into droplets.

of all organs, especially in the case of the liver and kidneys, generally under the influence of alcohol, and which, as has already been stated, tends to come on as age advances.

Here, again, we have impressed upon us the fact that alcohol tends to shorten life both by causing widespread degeneration and also by bringing on prematurely the special changes of old age. These changes in the case of the nervous system

are, of course, especially to be dreaded because of the accompanying mental deterioration—a deterioration which frequently makes life a misery, and which, at the very least, renders it useless and ineffective.

THE ACTION OF ALCOHOL ON THE EXTERNAL SKIN, AND ITS EFFECT ON THE REGULATION OF THE TEMPERATURE OF THE BODY

"I was twenty years older than any of the officers or crew, yet I could stand the cold better than any of them, who all made use of tobacco and spirits. I entirely abstained from them. The most irresistible proof of the value of abstinence was when we abandoned our ship and were obliged to leave behind us *all* our wine and spirits. It was remarkable to observe how much stronger and more able the men were to do their work, when they had nothing but water to drink."—Sir J. Ross, *Voyage to the Arctic Regions* (1829-33).

"The greater the cold the more injurious is the use of alcohol."—Dr. John Rae (Arctic Explorer).

CHAPTER VII

THE ACTION OF ALCOHOL ON THE EXTERNAL SKIN, AND ITS EFFECT ON THE REGULATION OF THE TEMPERATURE OF THE BODY

THE external skin of the body is composed of two main layers—

A. The EPIDERMIS (*epi*, upon; *dermis*, skin) or scarf skin, which forms the surface layer, and consists of several layers of cells, which are constantly being renewed from the layers below.

B. The DERMIS OR TRUE SKIN, which consists of a framework of connective tissue cells, surrounding various important structures known as—

(1) Hair sacs.
(2) Sweat glands.
(3) Oil glands.
(4) Nerves.
(5) Blood-vessels.
(6) Lymphatics.
(7) Fat cells.

FUNCTIONS OF THE SKIN

The skin has several functions, namely, those of—

(1) Protection.

(2) Excretion.

(3) Regulation of body temperature.

And it is the seat of the perception of touch and temperature sensations.

1. *Protection*

The value of the skin in protecting the various tissues and parts of the body requires no special demonstration here.

2. *Excretion*

In addition to the function of regulating the body temperature, which we shall deal with at length, the skin has an important duty to perform in helping to rid the body of minute quantities of certain little-known effete products by means of sweat glands. These materials in the blood are brought by the blood-vessels to the neighbourhood of the sweat glands, which abstract the waste matters therefrom and excrete them from the body dissolved in the sweat.

It may easily be understood that any interference with the normal local activity of the blood-vessels and glands will lead to impairment of this excretory function of the skin, and consequently to impairment of health generally. As we are about to show, alcohol notably interferes with the normal condition of the blood-vessels, and thus indirectly with the excreting functions of the skin.

3. *Regulation of Body Temperature*

One of the main functions of the skin in man is the regulation of the body temperature, which is accomplished by means of the nervous system causing and controlling variations in the size of the blood-vessels of the skin.

Many thousands of small blood-vessels ramify in and supply the skin, and these have a valuable nervous mechanism by means of which they can alter their size according to the needs of the body, every blood-vessel being supplied with a network of fine nerves which control its size. Now these nerves are very susceptible to influences, such as a slight shock, which readily causes a momentary paralysis of their controlling power, and in an instant the blood-vessels dilate and we have the well-known phenomenon of blushing.

As a rule the blood-vessels are kept by their nerves in a medium condition of being neither too large nor too small, but ready to respond to the requirements of the body. For instance, on a warm day these vessels dilate and permit a considerable amount of blood to come to the surface of the body, and thus increase the loss of heat, for the air surrounding us is nearly always cooler than the body. It follows that we give off heat to the atmosphere, and that we do so more rapidly if our skins are flushed with blood. Consequently, whenever our skin-vessels are dilated and full, the body is cooling and our temperature is being lowered.

Effect of Alcohol on the Blood-Vessels of the Skin

Now alcohol causes a slight paralysis of the nerves controlling the blood-vessels of the body, and, as a consequence, these dilate and permit of more blood entering each little tube. This dilatation of the thousands of tiny vessels that course through the skin results in much of the blood in the body being able to reach the surface and become rapidly cooled. Physicians at one time attempted to make use of this fact by ordering alcohol to be given internally in cases of high fever, so that the temperature of the patient might be lowered. But in daily life persons very rightly dread any lowering of their normal temperature by alcohol, as this occurs at the expense of the internal organs, and may, if excessive, lead to exhaustion and risk to life. Practical experience of this risk leads to caution on the part of those who work in cold climates.

In Canada the men who are called lumberers live in camps far away from civilisation. During the whole winter they fell the trees, and these are dragged along the snow to the nearest river, where they are made up into rafts. These men will not have any alcohol near them in the winter. On one occasion a man conveyed a cask of whisky into one of their camps, and the first thing they did was to take an axe and knock a hole in the cask, so that the whole of the whisky ran out. The reason of this was, they did not dare to have the whisky there, for if it was there they felt quite sure they would drink it, and if they drank it they were likely to die.[1]

[1] Sir T. Lauder Brunton, *The Action of Medicines*.

A party of engineers were surveying in the Sierra Nevada. They camped at a great height above the sea-level, where the air was very cold, and they were miserable. Some of them drank a little whisky and felt less uncomfortable; some of them drank a lot of whisky, and went to bed feeling very jolly and comfortable indeed. But in the morning the men who had not taken any whisky got up all right; those who had taken a little whisky got up feeling very unhappy; the men who had taken a lot of whisky did not get up at all: they were simply frozen to death. They had warmed the surface of their bodies at the expense of their internal organs. Some time ago Sir Joseph Fayrer was out deer-stalking in the north of Scotland. He offered his flask to the keeper. The keeper said, "No, Sir Joseph, I will not take any to-day; it is too cold." And yet if he had drunk the whisky he would have felt for the time being very much warmer than before. So that alcohol tends to act as an antipyretic by dilating the vessels of the skin, and so allowing a loss of heat.[1]

The discovery that alcohol actually lowered bodily temperature was an event of considerable importance, and many careful investigations on the matter were made by Sir Benjamin Ward Richardson, M.D., before he finally laid the facts before the British Association in 1866.

So great in those days was the belief in alcohol that his report was gravely questioned and was handed back for correction. The observations, however, proved to be perfectly accurate. These showed that under the influence of alcohol the temperature

[1] Sir T. Lauder Brunton, *The Action of Medicines*.

of the body was liable to fall from three-quarters to three degrees. The evidence proved, moreover, that this depression of temperature was not transient, but persisted for several days after dosage.[1]

"Various observers have found that alcohol taken in ordinary quantities as a beverage causes a slight depression, generally less than half a degree, in the temperature of healthy men: on the other hand, poisonous doses may cause a fall of five or six degrees—in fact, many of the lowest temperatures recorded in man have been observed in drunken persons exposed to the cold."[2]

The shivering fits on recovery from drunkenness are a matter of common observation, and are due in great measure to the fact that the body has lost a considerable amount of its normal heat.

This lowering of temperature by alcohol often ends in loss of life. It is, indeed, very dangerous for a drunken man to lie out in the cold, on account of the fact that his body is liable to cool unduly fast. Many cases of so-called "death from exposure" are due in reality to alcohol, and many verdicts would be more accurate if they stated that death was due to the combined effects of alcohol and exposure.

The experience of all Arctic explorers is unanimous on this matter; indeed, it is by them regarded as indicating lack of wisdom if a man take alcohol with the idea of warming himself, seeing that by so doing

[1] *Cantor Lectures*, p. 70

[2] *Text-Book of Physiology*, edited by Professor Schäfer, art. by M. S. Pembrey on "Animal Heat."

he is in reality cooling his body and possibly risking his life.

In fact, the failure of certain expeditions has been partly due to ignorance or neglect of warning on this point.

Dr. Nansen[1] writes :—

"My experience leads me to take a decided stand against the use of stimulants and narcotics of all kinds. . . .

"It is often supposed that, even although spirits are not intended for daily use, they ought to be taken on an expedition for medical purposes. I would readily acknowledge this if any one would show me a single case in which such a remedy is necessary; but till this is done I shall maintain that the best course is to banish alcoholic drinks from the list of necessaries for an Arctic expedition."

Temperature also lowered by Chloroform and Ether.—As we have already suggested, other narcotics besides alcohol have this power of lowering the temperature of the body. Chloroform and ether (especially, as Dr. Hare has shown, the latter) act thus, and those who have been subjected to their influence recover better if their bodies be kept warm with hot bottles, etc., for some hours until their normal heat is recovered.

The diminution of the sense of touch, etc., caused by alcohol is due to the direct action of the drug on the brain, and is dealt with (Chap. V.).

Illusory Feeling of Warmth caused by Alcohol.—

[1] *The First Crossing of Greenland.*

Alcohol is undoubtedly often taken merely in order that a feeling of warmth may be experienced. For example, the cabman drinks that he may "feel" warm, although in a short time, having lost heat by taking alcohol, he again feels cold and shivers. He drinks once more—each time driving the blood to the surface and parting with valuable heat that ought to have been stored all the time in the centre of his body.[1]

The cause of this illusory feeling of warmth is as follows: the flow of blood to the surface of course warms the skin and the ends of the nerves in the skin, and these convey to the brain a feeling of warmth. But this does not really mean that heat has been added to the body. For instance, in blushing there is a *feeling* of heat, but, needless to say, the body is not really any warmer, the blushing being merely due to the temporary dilatation of vessels, whereby a sudden diversion of warm blood to the surface occurs.

Effect of Alcohol on the Health of the Skin.—In many persons quite small doses of alcohol taken daily suffice to cause alterations in the skin. The circulation through the skin itself being slower than it should be (because of the widened channels), the local nutrition of the integument suffers. The epidermis is imperfectly thrown off and eruptions often appear, which are the cause of considerable discomfort. In

[1] The best drink for any one who is cold, and has again to face the cold, is plain hot water, or fresh tea, or hot milk.

some persons there occurs a thickening of the skin and very commonly an inflammation of its small glands, which become filled with matter. In others the prolonged and steady taking of alcohol reduce the blood-vessels of the skin to a state of more or less permanent dilatation. The face becomes flushed and red, and in cold weather the skin takes on a dull leaden hue or a purple bloated look, due to a poor and sluggish circulation of badly aerated blood. Minor signs of the silent, steady, undermining action of alcohol are constantly noticeable, both in the faces of recognised drinkers and in the faces of men and women who are considered by their own friends to be comparatively hale and well.

We feel, however, it is necessary to point out that various other conditions produce a similar dilatation of the blood-vessels of the face, and that medical skill is required in order to diagnose between the condition above described and that due to frost-bite or to grave organic disease of the heart or other organs.

The alcoholic dilatation of the vessels of the skin is frequently an index to the state of the blood-vessels of the internal organs, dilatation of which is a matter of grave import, seeing that the over-engorgement of the internal organs with blood leads slowly and surely to the degeneration of their secreting protoplasm, and consequently to loss of that health and efficiency which must be possessed by these vital parts if life is to be prolonged.

THE DIGESTIVE SYSTEM

"But it is, above all, by its action on the general nutrition that alcohol weakens. It creates want of appetite, nausea, irregular and insufficient nutrition, indigestion, and consequently a faulty elaboration of the food. In the long run, and in consequence of very complex mechanism, it creates a poor nutrition with all its consequences. Fatness, and sometimes leanness, all sorts of non-assimilations, are the signs which are apparent. The general alteration of the body, the sign of its being out of gear are represented, as we know, by shortening of the length of life and by the early appearance of the decrepitude which signifies old age."—M. le Docteur Legrain, Senior Physician to the Asylum Ville Everard (Paris). Speech at the International Congress on Alcoholism at Bremen, April 15, 1903.

"Concerning the beneficial influence which alcohol is believed to have upon digestion, we must allow considerable room for doubt. The majority of authors who have experimented along this line conclude that even small quantities of alcohol *retard* gastric digestion, and larger doses cause cessation of digestion."—Holsti.

CHAPTER VIII

THE DIGESTIVE SYSTEM

In view of the great importance of this part of our subject, it is desirable that the student should have some comprehensive conception of what is implied by the term digestion.

The digestive canal has been aptly compared to a chemical factory, where the raw material is gradually converted from food-stuffs into completely different substances, which, being absorbed into the blood-stream, are carried thereby to the (protoplasmic) tissues which compose the structure of the body.

By the processes of digestion, which are essentially chemical, food-stuffs are reduced to a state of solution, in which condition they are absorbed into the body-fluids and used for the maintenance of life. We can picture this occurring in the following way. The factory consists of a series of workshops, each of which is provided with suitable reagents. As the food passes through these chambers, various portions of it are selected and acted upon, the rest of the material being passed on for alteration elsewhere. The reagents

themselves are prepared on the factory premises, many of them being elaborated in little rooms buried in the walls of the large workshops. Of these tiny compartments there are many thousands. In other cases the reagents are prepared in distant quarters, which are connected, as in other large chemical factories, with the main laboratory by a series of tubes. These latter are the so-called ducts of the accessory glands, *e.g.* salivary, pancreatic, liver, etc. Food being ordinarily formed of many and various ingredients, naturally requires a series of different digestive juices for its transformation. Each part of the workshop furnishes a special fluid, which is capable of acting on certain portions of the food. Hence it is of first importance that all the departments of the workshop should be in good working order, so that the juices supplied may be of the quantity and quality needed for the perfect carrying out of the elaborate process of digestion. Any injury to, or partial destruction of, any of these smaller chambers must of necessity limit the scope of the intricate reactions taking place therein.

The large central part of the workshop is divisible into three compartments, which form sections of a large tube :

I. The Mouth,
II. The Stomach,
III. The Bowels.

Their relation to one another and to the various large glands concerned in digestion may be grasped in a moment by studying Fig. 14.

The whole tube is lined with mucous membrane, which thus forms a kind of internal skin. It is most important that we should first review in a general

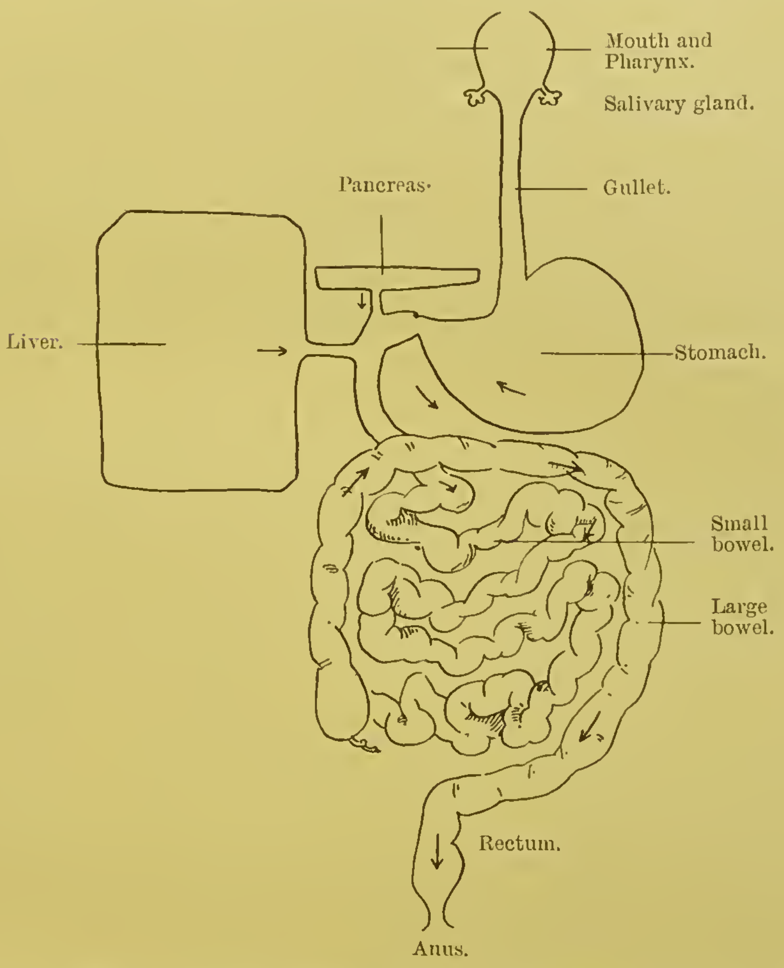


FIG. 14.—Diagram of the Alimentary Tract. This figure is only a rough diagram to show the relative position of the different parts, namely, the tube (gullet—stomach—bowel), and the glands which pour their secretions into it (salivary—liver—pancreas). The course taken by these secretions and by the food as it passes downwards (becoming digested) is indicated by the small arrows.

manner the characteristics of this tissue, and then study the effects upon such a lining membrane produced by a drug like alcohol.

The Mucous Membrane

The delicate membrane covering the lips and lining the mouth, and continued from the mouth downwards throughout the stomach and bowel, is so transparent that the pink colour of the under-lying structures, such as the muscles, may be easily recognised. All along its course there lie beneath it tissues rich in blood-vessels and nerves, each of which is affected by anything that irritates the surface of the mucous membrane.

This internal skin or lining is far more sensitive to local conditions than the external skin which we described in the last chapter, and is therefore very readily affected by chemical substances. The comparison between the two skins may be brought out by touching them both with moistened mustard. The mustard will lie on the external skin for several minutes before its presence is shown by a sense of heat and tingling: but the same amount placed on the tongue causes an immediate sensation of heat and stinging pain, followed by rapid dilatation of blood-vessels and the formation of a blister or sore, unless the irritant be speedily removed.

The first action of any substance placed on the surface of a mucous membrane is naturally upon the very delicate protoplasm of the cells, which built up together comprise the surface of the internal skin.

Effect of Alcohol on the Mucous Membrane

The effect of alcohol upon all protoplasm is to cause it to clot and coagulate.

Alcohol produces a cloudiness in the protoplasm, which means that its active living constituents are undergoing the first stage of degeneration. At a later stage the cell shrinks, becomes granular, and is thrown off or shed. When this occurs in the cavity of the stomach it results in patches of the lining membrane becoming more or less denuded of their natural covering.

In addition, the mouths of the glands which secrete gastric juice become blocked with this débris of epithelial cells and with mucus, which is secreted in excessive quantities as a direct effect of the presence of alcohol.

Those who are wise avoid taking irritants, and thus preserve the delicate structure and the activity of the mucous membrane of the stomach; whereas those who are careless in this matter become liable to the onset of digestive difficulties, which often first show themselves in feelings of irritability and depression. These failures in the digestive apparatus lead to ill-health and, therefore, to lessened power of work, and, ultimately, to more or less general physical deterioration; for no one can go on living vigorously with a worn-out digestive system.

With regard to children this caution may be emphasised tenfold. If a child's delicate stomach be

irritated, a condition of affairs is soon set up which may throughout life be a source of impaired nutrition, and deprive him of his full share of strength and happiness.

Now alcohol essentially belongs to the class of substances known as irritants, its effect depending upon the strength of the solution used. For instance, brandy (which is a mixture of about equal parts of alcohol and water) when dropped into the eye causes intense irritation, pain, and congestion.

This effect, which can readily be tested by the reader, is nothing more or less than that which occurs in the stomach also. The blood-vessels of the stomach are just as small and delicate as those of the eye, indeed we have it stated by the most recent authority that "of all the blood-vessels those of the abdominal cavity are most easily dilated by the local application of alcohol."[1]

Moreover, as soon as the inner lining of the mucous membrane loses part of its surface, its blood-vessels are more directly exposed to and acted upon by alcohol or any other irritant; consequently the congestion is more marked and finally becomes chronic.

This destructive process proceeds in varying degrees according to the amount of alcohol taken, and one of the commonest changes produced in the protoplasm of the epithelial cells of the membrane

[1] *Alcohol and the Cardio-Vascular System*, by T. K. Munro, M.A., M.D., and J. W. Findlay, M.D.

by much smaller doses of irritant chemical substance is that which we shall see very markedly exhibited in the liver, kidney, and other glandular organs—namely, fatty degeneration. A lining cell thus altered is, of course, useless and is rapidly shed.

In concluding this general sketch of the changes in the mucous membrane of the alimentary tube when exposed to contact with alcohol, it ought to be mentioned that the cells covering the surface have a definite physiological function and share in digestion as such, from the commencement of the stomach to the end of the bowel. This function is that of active selective absorption, and probably includes even more complex powers. These all-important cell activities, of course, are abrogated by the persistent application to the protoplasm of the cell of any destructive agent such as alcohol, the injury being (as before stated) parallel to the strength of the solution of alcohol taken.

The Mouth

The work done in the mouth is as follows:—

(*a*) The food-stuffs are tasted and tested by nerves residing chiefly in the tongue.

(*b*) The food-stuffs are broken up by the machinery of the teeth.

(*c*) Salivary glands pour out a juice, the saliva, for the digestion of the starchy matters in the food.

When taken into the mouth, alcohol has the following effects :—

1. The Mucous Membrane tends to become Hardened

If brandy or liqueur be retained in the mouth for a short time the mucous membrane becomes white and corrugated, owing to the dehydration and commencing coagulation of the tissue protoplasm. This definite hardening of the internal skin of the mouth is a fact made use of by dentists, who order mouth-washes containing alcohol partly because of its action in this direction. Now although unhealthy gums may sometimes require a hardening treatment, the tongue certainly only suffers if substances be applied to it that thicken or alter its surface in any way, for it is meant to be an organ of great sensitiveness and discrimination with regard to the sense of taste. The nerves of taste are situated just beneath the mucous membrane, and it stands to reason that if this membrane be hardened and thickened, their power of sense perception will be delayed and their finer accuracy impaired.

2. Alcohol further delays Taste-Perception by deadening the Nerves of Taste

(*a*) By acting locally.

(*b*) By acting on the general nervous system as a depressant (see Chap. V.).

Probably no one who drinks alcohol realises that his sense of taste is being numbed ; he merely enjoys

the feeling of relief which comes when he adds a glass of beer to a badly cooked meal. Nevertheless, the ignorance which leads a wife to rely upon dinner-beer as a supplement to careless cooking of this important meal is much to be deplored; for her husband will return to his work less well nourished, although the partially deadened state of his nerves will prevent him from being aware of the fact at the moment. This is all part of a vicious circle of events, because alcohol produces much more destructive effects upon persons who are badly nourished.

It is stated that at some public-houses good tasting beer is given as a first draught; and then (when this has slightly deadened the delicacy of taste) subsequent glasses are given of an inferior quality, even salt being sometimes added so as to increase the thirst of the buyer.

3. Alcohol stimulates the Flow of Saliva and Gastric Juice

Like any other irritant, alcohol when in the mouth stimulates the nerves, and, by reflex action, causes an extra secretion of saliva. Now this extra flow of saliva due to the action of alcohol is not needful to the economy, because food when taken into the mouth and kept there a reasonable time calls forth a supply of saliva adequate to the purposes of preliminary digestion.

With reference to a common statement that alcohol in the mouth causes reflexly a flow of gastric juice in

the stomach, it has clearly been proved upon dogs by the latest scientific investigation on digestion[1] that in a very remarkable way the gastric juice is secreted in proportion to the amount of food taken. Alcohol is, therefore, not needed to cause an adequate flow of gastric juice.

4. **Alcoholic Pharyngitis**

When alcohol is taken into the mouth increased vascularity results, and chronic irritation is set up in the pharynx (*i.e.* the back of the throat) of people who habitually drink alcohol.

These persons are constantly under the necessity of clearing their throats, to get rid of the tenacious mucus which is secreted in direct response to the irritation of the alcohol.

From the mouth the alcohol swallowed passes through the pharynx and gullet to the stomach.

The Stomach

The stomach is a large muscular bag, lined with a delicate type of mucous membrane. During a meal the food is driven by each act of swallowing down the gullet into the stomach and collects there. Even while the food is being chewed in the mouth, a fluid, the gastric juice, is by reflex action secreted in the glands of the stomach and its cavity, and this fluid is formed with still greater rapidity when the food actually enters the stomach.

[1] Pawlow, *The Work of the Digestive Glands*, 1902.

If the stomach of a pig be obtained and examined

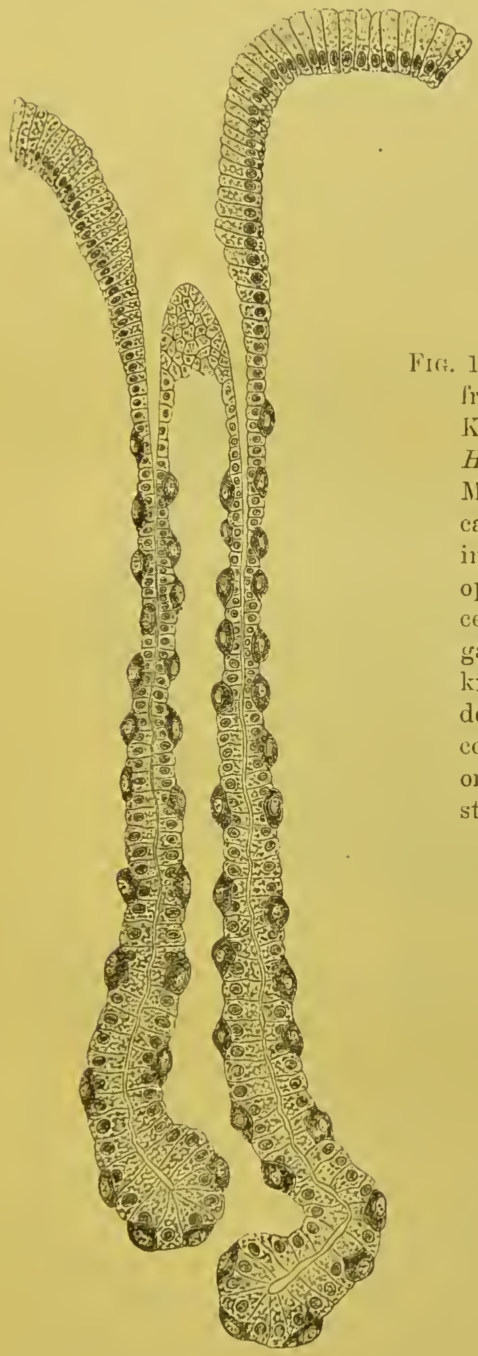


FIG. 15.—Drawing of the tubular glands from the stomach. Copied from Klein and Noble Smith's *Atlas of Histology*, by kind permission of Messrs. Smith, Elder, and Co. The cavity of the stomach is the space into which the tubes of the glands open by a common mouth. The cells or corpuscles which secrete the gastric juice are seen to be of two kinds, one globular and staining deeply, the others granular and columnar in shape. Each corpuscle or cell has its nucleus which is stained.

on its interior surface with the aid of a hand lens, tiny openings may be seen. These are the mouths

of the *glands* of the stomach which secrete gastric juice. There are about 5,000,000 of these in the stomach of a human being.

The effective mixture of gastric juice and food is ensured by active churning movements of the stomach, the walls of which are muscular (Fig. 16) and contract, waves of constriction passing along the organ, and,

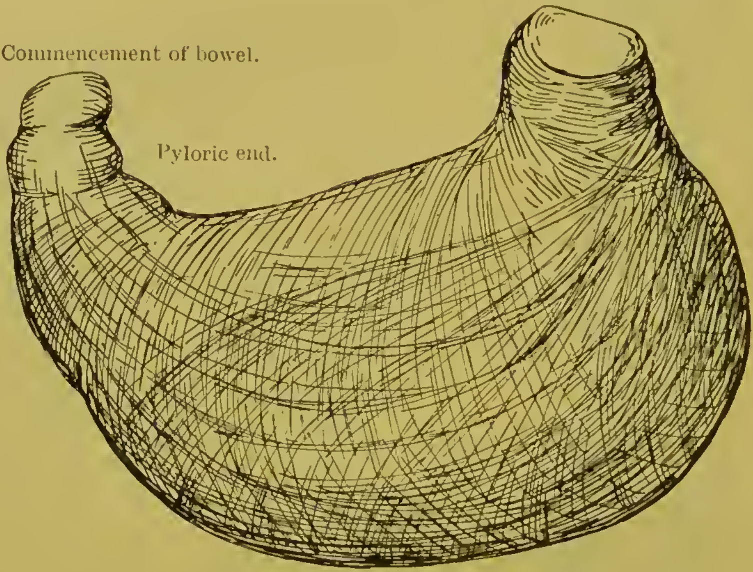


FIG. 16.—A human stomach which has been separated from the gullet and bowel, and dissected to show the bundles of muscle fibres which envelop it and enable it both to keep up churning movements, and by shortening its long axis drive the food onwards into the bowel.

after thus causing a thorough admixture with the gastric juice, driving the stomach contents on into the beginning of the intestine. Thus as the stomach contents become semi-digested, the strong ring of muscle closing the pyloric end of the stomach relaxes, and the food in a semi-digested state is pushed on into the small intestine, where its digestion is further elaborated by the fluid food being mixed with two

most important digestive juices, bile and pancreatic juice. (For the action of these see Starling's *Primer of Physiology*, p. 38.)

In performing all these movements the muscular wall of the stomach is controlled by nerves, connected with the spinal cord and also indirectly with the brain; and it is important to remember that anything that depresses these gastric nerves enfeebles the muscular movements of the whole stomach and delays digestion.

Action of Alcohol on the Stomach

We may best study this question by considering:

Section I. The effect of alcohol on an empty stomach, when taken on rising in the morning, or at irregular times during the day.

Section II. The action of alcohol on the food-stuffs themselves, and upon the chemical processes of digestion outside the stomach.

Section III. The effect of alcohol on the process of digestion, when it is taken at the same time as food.

Section I. The Action of Alcohol upon an Empty Stomach

The local action of alcoholic liquids upon an empty stomach is destructive, particularly when taken in the form of spirits or in any strong solution.

We have already explained the delicacy of the

structure of the lining mucous membrane and the importance of swallowing only such substances as shall not cause irritation or injure this lining to the detriment of the glands.

Now alcohol undoubtedly causes both irritation and destruction of gastric gland-tissue when taken into an empty stomach, and from innumerable observations on man and on animals it is certain that the early dram acts in the following way :—

(1) The lining membrane of the stomach becomes bright red owing to the dilatation of blood-vessels, and, because the glands are also stimulated, a needless secretion of gastric juice occurs. This gastric juice is accordingly wasted, inasmuch as no food is taken at the same time to be digested.

(2) The delicate unprotected protoplasm of the mucous membrane is irritated just as the protoplasm of the nose may be irritated by pepper. Catarrh follows, and an unhealthy slimy secretion of mucus is poured out which coats the stomach walls. This mucus (which is like the mucus which pours from the nostril during a heavy cold) when frequently secreted becomes a source of great discomfort to the sufferer, being accompanied by both nausea and vomiting.

The misery and dyspepsia of chronic alcoholics, and of many who only take alcohol in most moderate doses, is directly caused by this condition of gastric catarrh.

(3) The mucous membrane from which the epi-

PLATE VIII

This plate shows the interior of a healthy stomach. The lining membrane lies in folds and depressions, and is uniform in appearance and of a healthy colour.

PLATE IX

In this drawing (copied with kind permission of Hrn. Lehmann and Co., from Prof. Bollinger's *Atlas of Pathological Anatomy*) are seen the local patches of congestion and erosion caused by alcohol. Note also the pale, anæmic areas and the general unhealthy tinge of the whole interior of the stomach as compared with Plate VIII.

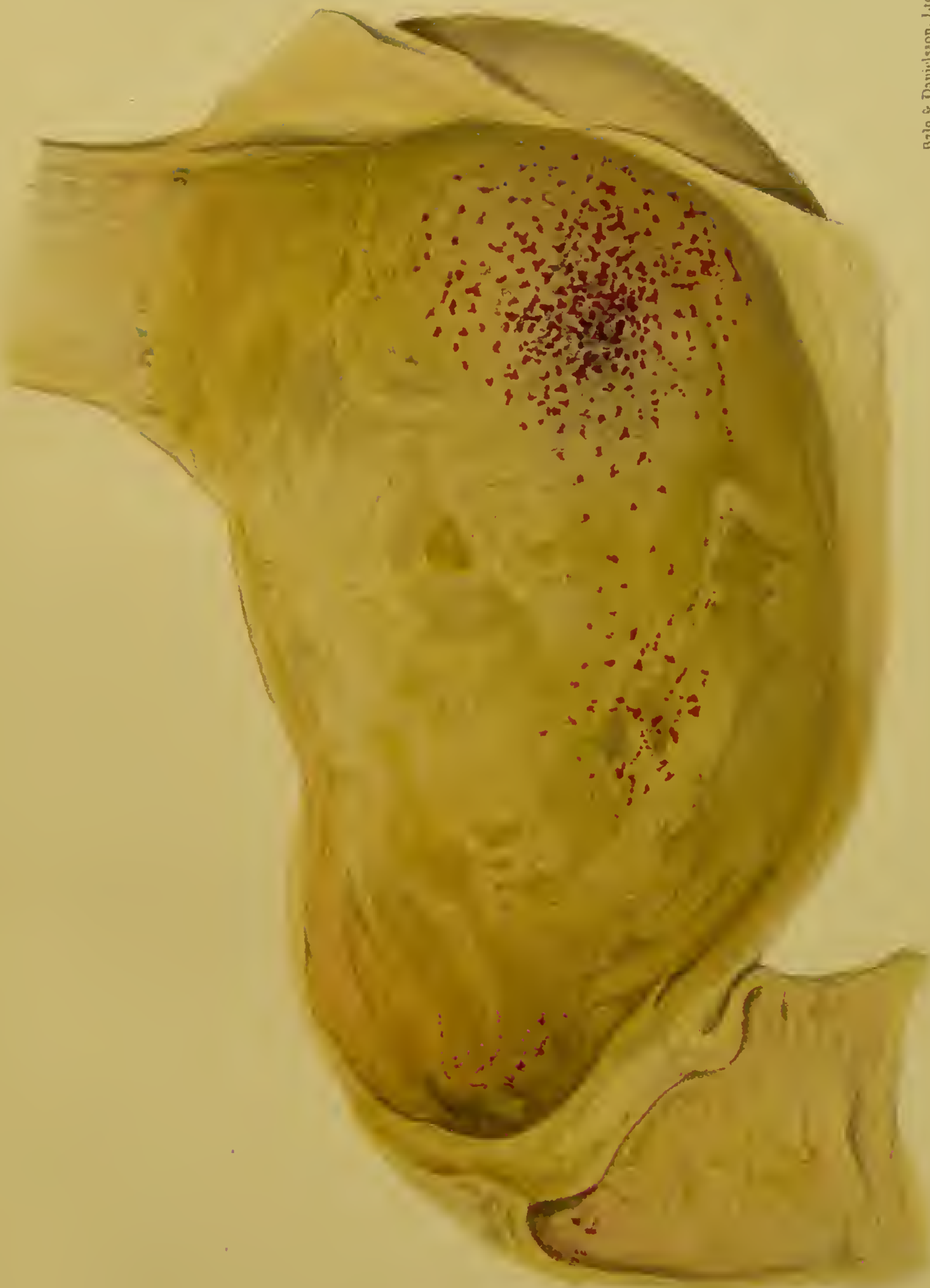
PLATE VIII.

NORMAL STOMACH.

A. M. Kelley, del.

Bale & Danielsson, Ltd., Lith.

PLATE IX.



STOMACH OF AN ALCOHOLIC.

Bale & Danielsson, Ltd., Lith.

To face Plate viii

thelial protoplasmic cell-lining has been partly lost is further attacked, becomes inflamed, and is ultimately permanently injured in parts. When this final stage occurs the glands cannot act, and the secretion of gastric juice being diminished, the processes of digestion are impaired.

(4) Another, and a very important sequence of taking alcohol, is due to its paralysing effect upon the nerve-supply and walls of the blood-vessels of the stomach-wall. The stomach is very richly supplied with blood-vessels, and if these become dilated and engorged with slowly moving blood, a state of commencing local inflammation supervenes. The stomach of a chronic alcoholic shows patches of inflammation which vary in size. In Plate IX. may be seen a number of red spots which represent small acutely inflamed patches. These patches often become areas of definite excoriation, and are sometimes as large as a shilling piece, or even larger.

Such patches of superficial erosion or ulceration not only directly interfere with the gastric functions, but also form avenues for the easy introduction into the system of microbes, the germs of infectious diseases.

Investigation by Dr. Beaumont

The exact condition of the lining membrane of the stomach under the action of alcohol was observed many years ago by a certain Dr. Beaumont. His patient was a man called Alexis St. Martin, who injured him-

self very seriously by the explosion of a gun. Only after many months did he recover, and even then a hole in the front of his body refused to heal properly. This led into his stomach, and through this hole the condition of that organ could be observed. Dr. Beaumont invited Alexis to become his attendant and to stay with him, on condition that he would allow his stomach to be observed from time to time; and in this way, for years, careful observations and notes were made. The man was in good health in spite of the opening; in fact, he married and had children.

An extract from Dr. Beaumont's diary runs as follows:—

St. Martin has been *drinking ardent spirits pretty freely for eight or ten days past*; complains of no pain, nor shows symptoms of any general indisposition; says he feels well, and has a good appetite.

August 1, 8 A.M.—Examined stomach before eating anything; inner membrane morbid; considerable erythema, and some aphthous patches on the exposed surface; secretions vitiated. Extracted about half an ounce of gastric juice: not clear and pure as in health; quite viscid.

August 3, 7 A.M.—Inner membrane of stomach unusually morbid; the erythematous appearance more extensive, and spots more livid than usual; from the surface of some of which exuded small drops of grumous blood, the aphthous patches larger and more numerous, the mucous covering thicker than common, and the gastric secretions much more vitiated. The gastric fluids extracted this morning were mixed with a large proportion of thick ropy mucus, and considerable

muco-purulent matter, slightly tinged with blood, resembling the discharge from the bowels in some cases of chronic dysentery. Notwithstanding this diseased appearance of the stomach, no very essential aberration of its functions was manifested. St. Martin complains of no symptoms indicating any general derangement of the system, except an uneasy sensation and a tenderness at the pit of the stomach, and some vertigo, with dimness and yellowness of vision on stooping down and rising again; has a thin yellowish-brown coat on his tongue, and his countenance is rather sallow; pulse uniform and regular; appetite good; rests quietly, and sleeps as well as usual.

We have introduced these quotations in full in order to emphasise the point that there may be considerable damage to the stomach without the patient being aware of the fact. Therefore it is useless for any one to rely entirely on his feelings in this matter, for often it is only later on, when the catarrh becomes permanent, that the misery we have mentioned is felt by the drinker and recognised as a warning, even if he does not attend thereto.

Action of Dilute Solutions of Alcohol (such as 5 per cent and 3 per cent beers) on the Empty Stomach

So far we have described the effects of strong solutions of alcohol (*e.g.* spirits) on the gastric mucous membrane. We must now consider the effects of such liquids as beer. The experiments referred to in Chapter III. prove that the protoplasm

of the lower forms of animal and vegetable life are disastrously affected by very dilute (1 per cent) solutions of alcohol—their life-functions of nutrition, reproduction, and movement being carried on under increasing difficulties when they are exposed to the influence of alcohol, even to what is commonly regarded as a trivial degree.

Now, each of the minute cells lining the stomach has life and vitality, just as much as an amœba. It has less power of movement than the amœba, but is by no means altogether motionless, being swayed by the currents which pass through its protoplasm, and able to take in and extrude material that surrounds it. It is a cell of the type of the amœba, but highly differentiated (*i.e.* set apart) for the elaborate work of secreting mucus or gastric juice as the case may be.

Considering this likeness, it is *a priori* likely that it too would be susceptible to the presence of dilute solutions of alcohol in the same way as the cells and unicellular animals described in Chapter III.

And this is the case: for the man or woman who repeatedly drinks beer usually suffers from a chronic gastric catarrh, due solely and entirely to the habit of flooding the stomach with weak alcoholic liquids.

Moreover, the very fact of introducing beer into the stomach when it contains no food (*i.e.* between meals) tends to irritate the peptic glands, to upset their method of work, and to render their subsequent secretion imperfect when required for digestive pur-

poses. Thus, indirectly, the digestion of meals is interfered with, for when the hour arrives at which food should be taken, the stomach is already in a state of unrest, and therefore more or less unfitted for its task.

All the evidence shows that just as strong solutions of alcohol are more or less rapidly harmful to the digestive organs, so smaller doses are liable ultimately to affect those organs in a slower though similar way—the effects of repeated small doses of any poison having the power of mounting up to a very definite item as the years go by. It is universally admitted that the habit of taking dilute solutions of alcohol on an empty stomach between meals is very bad for the individual. It is therefore harmful to the nation at large.

Effect of Alcohol on the Churning Power of the Stomach.

From this description of the local effect of alcohol upon the internal lining of the stomach we must now pass on to consider its influence upon the muscular work that the stomach walls are required to perform. Whether the alcohol be taken on an empty stomach or with food is immaterial as regards this particular question of muscular activity, because the result is not due to any direct local action of the drug on the stomach wall, but to its influence on the central nervous system, as explained in Chapter V.

It is of the greatest importance, from a digestive

point of view, that the vigour and churning power of the muscles of the stomach should be unimpaired. As this vigour depends largely upon the nerves which control the muscles, anything which lowers the working power of these nerves renders the movements of the stomach muscles slow and languid, and delays their full contraction.

We have shown that under alcohol the nervous system is not stimulated but depressed, and herein lies the explanation of the enfeebled action of the muscles of the stomach now under consideration.

Whether taken alone or with food, the tendency of alcohol throughout is to lessen the vigour of the muscular movements of the stomach, and this delay further tends to lead in the course of time to a state of chronic atony (*a-tonus* = lack of tone) of that organ. Thousands of men and women suffer unconsciously from this condition of lack of muscular tone in the stomach—due often to overwork and fatigue, but often also to the action of alcohol in causing delayed motility, which delay means that the normal rate of digestion is prolonged. This prolongation leads to further disadvantages, for the stomach is deprived of its needful periods of rest, and hence its power of secreting effective gastric juice is liable to become impaired. Digestion consequently is disturbed, and, as there is no doubt that the products of disturbed digestion exert a very material influence in causing deterioration of our tissues, this is obviously a condition to be avoided if possible.

The fact that many delicate persons gradually improve in health when they give up taking alcoholic drinks is to be accounted for by the improvement in their digestion. Their slight gastric catarrh ceases by degrees; the motor power of their stomach becomes more effective, and consequently their ability to obtain value from their food is increased.

Chronic atony leads by no means infrequently to a still worse condition, which we know medically under the term of "Chronic Dilatation." In this condition the stomach never contracts fully and effectively so as to expel its contents into the bowel; hence it always contains some remnants of a meal, which ferment and cause "wind." This in its turn tends to inflate the stomach and itself to increase the dilatation, and thus the "vicious circle" goes on.

Sometimes a stage is reached in which the distension of the stomach takes place very rapidly and acute dilatation occurs, the patient then being in danger of his life.

Alcohol as a Disinfectant

It is sometimes asserted that the taking of alcohol into the stomach has this advantage, that it is able to exert a kind of disinfectant effect, and it is able to destroy microbes which are the cause of disease. As a matter of fact, it has little influence of this kind in the quantity that can be tolerated in the stomach.

It certainly enables the person who takes it to get rid temporarily of the "wind" which is distending

his stomach, probably by relaxing the muscular rings which close the passage from the stomach into the bowel, on the one hand, and from the stomach to the gullet on the other. This temporary relief is, however, very dearly bought, because the alcohol, on the other hand, causes mucus to be secreted which in itself leads to decomposition and fermentation, thus creating, as we have already pointed out, a "vicious circle."

Narcotic Effect of Alcohol

It is a matter of much interest and importance to note here that the discomforts enumerated above may be apparently lessened by taking more alcohol, which deadens the perceptive power of the brain, and hence renders the sensations of wretchedness and nausea less patent to the sufferer. This is one reason why the drinker craves to have "more," but of course by drinking he only increases his final miseries and shortens his life. No one whose digestive apparatus is seriously upset by alcohol can expect to live long. Some hale men certainly exhibit a tolerance of the drug that is remarkable, but it is found that their children are not able to take it in the same doses, and are often sufferers from various physical ills—showing that the action on these men is more potent than they imagine (see Chap. XVI).

The numbing effect of alcohol on the brain, and probably also on the nerve-endings in the mucous membrane of the stomach (Chap. V.),

is also made use of by many to allay the pangs of hunger. Often a hungry washerwoman, whose body really requires proper nourishment, will take stout and then declare that she "feels satisfied." The poor frequently drink from the desire to obtain the sensation of well-being provided by good food. Having assuaged the feeling of hunger by taking alcohol they conclude, erroneously, that they have consumed what is equivalent to a real meal! This false feeling of "being satisfied" is very disastrous to the body—which requires suitable food at proper times, and suffers in the long run if only a sedative (such as stout) be taken.

Effect of Alcohol on the Digestion of Women—Aperients

Alcohol appears to have a peculiarly deleterious effect upon the digestion of women. This is explained by the fact that men lead a more outdoor life, and consequently retain their appetite for food longer than do women. For this same reason they are able to work off the effects of drinking more easily, and start afresh the assimilation of food. The indoor life led by most women, and the tight clothing worn round their stomachs, are causes which lead them more readily to be disinclined for food, and when they take to alcohol the earliest effect is to lose their taste for regular meals. As a result of catarrh of the stomach caused by alcohol, an insufficient morning meal (possibly only a cup of tea) is

taken instead of a proper breakfast; consequently, from exhaustion, at 11 o'clock recourse is made to stimulants. After this there is no appetite for dinner, and exhaustion is again felt. More alcohol is taken as night comes on in order to induce sleep, and with the morning there is a recurrence of the feelings of nausea and sickness.

The distaste for food to which we have alluded leads to general bodily weakness and inaction, from which the bowels are not exempt. Aperients are resorted to, and a frequent effect of these is to cause feelings of exhaustion and faintness, which lead to the taking of stimulants, especially among women.

A firm stand ought to be made against the widespread use of aperient drugs without medical advice, not only on account of the general ill-effects of these medicines, but also since not infrequently their misuse leads to a resort to alcohol. The malady of constipation requires combating on sane and scientific lines. In the early training of children, in the construction of our school buildings, with a view to the recognition of the fact that health depends largely upon the habit, cultivated in childhood, of daily evacuation of the bowels; in the relaxation of any hard and fast rules which insist that a child shall be in its place at a certain hour, whether or no this evacuation has taken place; and, lastly, in the avoidance of astringent drinks, and in the frequent use of fruit as an article of diet, lies the correct method of avoiding constipation and its attendant evils.

Dyspepsia disguised by Alcohol but not Cured

It is a serious error to regard alcohol as a genuine remedy for dyspepsia and abdominal pain. Feelings of abdominal discomfort and pain (which are physiological warnings to the sufferer that he needs care) are, it is true, abolished by alcohol, and as a consequence of this many a man believes that alcohol materially aids his digestion, whereas it merely exerts a narcotic influence on the gastric nerves, and his dyspepsia is not removed but only disguised. In fact, instead of being cured the mischief is aggravated.

This narcotic action of alcohol in covering up symptoms is frequently made use of in many of the preparations on the market which are advertised as "aids to digestion." In numerous cases, instead of a cure being effected the taste for alcohol is established, to the lasting detriment of the patient.

Section II. Action of Alcohol on Food-Stuffs and upon the Chemical Processes of Digestion

In order that food-stuffs may be of value to the body, it is necessary that they should be reduced in the stomach and bowel to substances which are soluble and easily absorbed. It is desirable, therefore, that nothing should come in contact with the half-digested and semi-fluid food material which might alter it, and thus render more difficult the further processes whereby it is rendered more soluble and absorbed. Now

alcohol when present in considerable quantity has, as is well known, a hardening or coagulating (precipitating) effect upon a great many tissues and substances. Its use as a hardening and preserving agent is well known. If a piece of underdone meat or uncooked white of egg be placed in a mixture of equal parts of alcohol and water (the strength of ordinary brandy), this hardening gradually occurs. Similarly other proteids or albuminous substances when brought into contact with absolute alcohol coagulate into an insoluble material which thenceforth becomes practically useless as a food-stuff. It is, of course, not justifiable to conclude immediately from these facts that alcohol when swallowed has an equivalent power in the stomach of precipitating or altering albumins in food-stuffs, because the period of contact is under these conditions much shorter and the dilution greater.

With regard, therefore, to the important practical question of the effect of alcohol and alcoholic liquids upon digestion, Sir William Roberts made an extensive series of experiments in which digestive processes were conducted artificially outside the human body in glass tubes. Some of his results are given in the following tables :—

TABLE VIII.—SHOWS THE EFFECT OF PROOF SPIRIT, TOGETHER WITH BRANDY, WHISKY, AND GIN ON PEPTIC DIGESTION[1]

2 grams beef-fibre + 0·15 per cent HCl + 1 c.c. glycerine-extract of pepsin + varying proportions of proof spirit, brandy, whisky, or gin + water to 100 c.c.

Proportion of Proof Spirit, Brandy, Whisky, or Gin contained in the Digestive Mixture.	Time in which Digestion was completed (Normal, 100 minutes).
5 per cent . .	100 minutes
10 ,, . .	115 ,,
20 ,, . .	135 ,,
30 ,, . .	180 ,,
40 ,, . .	300 ,, embarrassed ; almost no digestion

This series of experiments showed that the presence of alcohol never appeared to accelerate the process of digestion, and that when it was present in the proportion of 10 per cent or more, it caused delay in peptic digestion, increasing with the percentage increase of alcohol present.

Sir William Roberts then investigated the effect of sherry and port, and found with these more retardation of digestion than he would have expected, considering that they contain only about 12 to 17 per cent of alcohol. On this curious point he writes as follows :—

Even in the proportion of 20 per cent, ~~e.g.~~ i.e. below 4 per cent of alcohol, sherry trebled the time in which digestion was completed. There must therefore be in these wines some retarding agent besides alcohol. . . . As used dietetically, sherry must figure as having an important retarding

[1] Sir W. Roberts, M.D., F.R.S., *Digestion and Diet*, 1891.

effect on peptic digestion. This wine is used by some persons very freely. Half a pint of sherry is no unusual allowance; and this in a total gastric charge of two pounds of food amounts to about 25 per cent, which the table shows to be a highly inhibitory proportion.[1]

TABLE IX.—SHOWING THE EFFECT OF SHERRY AND PORT ON PEPTIC DIGESTION

2 grams of beef-fibre + 0·15 per cent HCl + 1 c.c. glycerine-extract of pepsin + varying quantities of sherry and port + water to 100 c.c.

Proportion of Sherry or Port contained in the Digestive Mixture.	Time in which Digestion was completed (Normal, 100 minutes).	
	Sherry.	Port.
5 per cent . .	115 minutes	100 minutes
10 ,, . .	150 ,,	115 ,,
15 ,, . .	200 ,,	150 ,,
20 ,, . .	300 ,,	180 ,,
30 ,, . .	embarrassed; almost no digestion	200 ,,
40 ,, . .	...	embarrassed

Malt liquors were also proved to delay digestive processes.

Again we quote from Sir William Roberts:—

The retarding effect of malt liquors is (as is the case with wines) altogether out of proportion to their percentage of alcohol. These beverages contain only from 4 to 6 per cent of alcohol (8 to 12 per cent of proof spirit), so that the alcohol contained in them could scarcely ever, on its own account, produce any effect. Their retarding influence must, however, often come into operation. These beverages are used very freely with meals, and the digesting mass in

[1] *Digestion and Diet*, p. 134.

the stomach must often contain them in the proportion of 50 or 60, or sometimes even 80 per cent. Such proportions would act as powerful retardants, especially on the digestion of bread and other articles of farinaceous food.[1]

TABLE XI.—SHOWS THE EFFECT OF MALT LIQUORS ON GASTRIC DIGESTION

2 grams of dried beef-fibre + 0·15 HCl + 1 c.c. glycerine-extract of pepsin + varying quantities of malt liquors + water to 100 c.c.

Proportion of Malt Liquors contained in the Digestive Mixture.	Time in which Digestion was completed (Normal, 100 minutes).		
	Burton Ale.	Light English Table Beer.	Lager Beer.
10 per cent . .	115 minutes	100 minutes	100 minutes
20 ,, . .	140 ,,	115 ,,	115 ,,
40 ,, . .	200 ,,	140 ,,	140 ,,
60 ,, . .	embarrassed	180 ,,	180 ,,

Tea and coffee were also proved to retard gastric digestion; but the author gives no report concerning the effect of those weak infusions of tea which have lately come into vogue and which are little more than hot water.

In summing up the research, Sir William Roberts says:—

With the single and trifling exception of aerated (carbonated) water, I found that none of the various accessories which we use with food aided peptic digestion. The most favourable conditions for rapid digestion were obtained with hydrochloric acid, pepsin, and simple water. Even minimal quantities of alcohol, wines, tea, or coffee did not give the least assistance to the chemical process."[2]

[1] *Digestion and Diet*, p. 137. [2] *Ibid.* p. 141.

These test-tube experiments do not, of course, represent all the conditions that obtain when food is being digested in the stomach, but they certainly show that when alcoholic liquors are added to a mixture of gastric juice and food material, there is no increase in the rate at which the chemical processes of digestion proceeds.

In a similar series of experiments, Dr. Chittenden, of Yale University, observed that when the percentage of alcohol in the digesting mixture was as low as 1 or 2 per cent there was sometimes a slight acceleration of the rate of digestion, but he points out that—

> As the percentage of alcohol is raised, retardation or inhibition becomes more noticeable, although ordinarily it is not very pronounced until the digestive mixture contains 5 to 10 per cent or more of absolute alcohol.

He also lays stress on the fact that

> . . . with a weak gastric juice, where the amount of ferment present is small and digestive action consequently slow, or where the proteid material used is difficult of digestion, the retarding effect of a given percentage of alcohol is far greater than when the digestive fluid is more active.[1]

The net result of these investigations is certainly to show that all forms of alcoholic beverages seriously retard the chemical process of gastric digestion.

[1] *The Influence of Alcohol and Alcoholic Beverages on Digestion and Secretion.*

Section III. Effect of Alcohol upon Digestion when taken at the same time as Food

In order that the digestion of food may occur in a satisfactory way, three main conditions are essential:—

(1) There must be (*a*) nothing to prevent the gastric juice from rapidly reaching and penetrating the food-stuffs, or (*b*) nothing to prevent absorption from taking place when the digested material is ready to be taken up and absorbed.

(2) The gastric juice must not be diluted with much additional fluid.

(3) The stomach must not be dilated, and its churning movements must be energetic and not slow and feeble.

Now the presence of alcohol will either help forward these conditions, or it will hinder them, or it will not influence them in either direction. The question must be examined in these various aspects.

1. (*a*) With regard to the first condition, we have just seen that when alcohol is brought into contact with meat, eggs, etc., the peptic penetration and solution of such solid albumens is retarded and prevented. A practical demonstration of this is observed in the undigested lumps which compose the vomited meals of alcoholics. No gastric juice is strong enough to dissolve food in this condition, the

lumps therefore remain as "irritants," and with the also irritating alcohol are ejected from the stomach. While it is true that in the ordinary dietetic use of dilute alcoholic drinks actual precipitation or coagulation of food substances by the alcohol is difficult of proof, nevertheless the possibility of its occurrence when spirits are taken is a point to be remembered, as in such event active digestion by the gastric juice is practically abrogated.

(*b*) Many persons resort to alcoholic drinks at meal-times in order that the flow of gastric juice may be increased. Unfortunately, in addition to the moderate increase of secretion of gastric juice, a stimulation of the flow of mucus also occurs, which lies like a slime upon the internal surface of the stomach. This mucus is liable to hinder whatever normal absorption occurs from the stomach walls, and leads, as aforesaid (p. 205), to fermentation and the production of "wind" (*i.e.* gas) in the stomach.

2. In dealing with the second condition of good digestion, *i.e.* the inadvisability of free dilution of the gastric juice, we would point out that such dilution constantly occurs when draughts of beer are freely taken to "swill down" meals. This habit of drinking beer freely with food in no way tends to aid digestive processes. In fact, in addition to the retardation of digestion by the beer, the filling the stomach with considerable quantities of fluid causes distention, and renders more difficult its muscular contraction in a way now to be described.

3. Undoubtedly the great disadvantage of taking alcohol presents itself when we come to consider the churning movements of the stomach upon which digestion so largely depends, for alcohol lessens the vigour of these muscular movements, just as it lessens the force of all muscular activity. We have already described (p. 204) the reason of this delayed motility. Its occurrence has been proved by scientifically planned "test meals," which have been given to patients with and without alcohol, the results showing that although gastric secretion is admittedly somewhat excited by alcohol, the needful churning movements of the stomach are at the same time so considerably lessened and retarded that the net result works out as prejudicial to digestion.

Moreover, matters do not end here, for in addition to causing delay in the digestion of actual meals, this weakening of the muscular power of the stomach tends to permit of its chronic and gradual dilatation, in which state of weakness and loss of power it becomes a source of endless discomfort and wretchedness. Hundreds of men and women who haunt the out-patient departments of hospitals suffer from chronic atony and slight dilatation of the stomach, which arise in part from the badly cooked food they eat, but chiefly owe their origin to the debilitating effect of alcohol upon the muscular walls of this organ and the fermentation of its retained contents.

Bitters.—The discussion of the digestive value of alcohol is rendered somewhat complex by the fact

that it is frequently taken together with vegetable bitters—hops being the "bitter" most often employed. Now the bitter principles of many vegetable drugs are certainly of considerable value when occasion demands; they tone up a relaxed condition of the system and help the flagging appetite of an invalid or an overtaxed brain worker. Some of them, such as gentian, have few drawbacks, whereas, on the other hand, "hops," in addition to its bitter properties, contains an ingredient which causes drowsiness, and thus interferes with mental and physical vigour. Those who recognise that even small doses of alcohol are deleterious, can obtain the value of a "bitter" by taking it medicinally as a simple infusion, made up with some pleasant flavouring material. Nevertheless, it must be remembered that scientific evidence is not in favour of a constant resort to "bitters" or any artificial gastric stimulants.

Recent investigations with regard to digestion, made in Russia during a series of ten years by Professor Pawlow[1] and a number of expert assistants, show that the best stimulus of all to the flow of gastric juice is the condition of normal hunger, which is properly termed a healthy appetite, a more copious and effective secretion of gastric juice being produced than can be obtained by any drug stimulation.

Wine.—The question of the effect of wine on digestion is somewhat complex. As the "bouquet"

[1] *The Work of the Digestive Glands*, by Prof. Pawlow, St. Petersburg.

of a good vintage provides a pleasant momentary stimulus to the palate, it may reflexly cause secretory activity. On the other hand, the injurious effect upon digestion of the innumerable common and "made-up" wines that are upon the market is well known. Those containing tannic and other acids are astringent and harmful to the delicate "internal skin," and frequently cause constipation and its attendant evils.

The gustatory and narcotic effects of wines may give rise to pleasurable sensations, but we believe that pleasures of such a kind will be relinquished by many in proportion as knowledge spreads regarding the close association between alcohol and disease.

Reviewing the whole subject of the bearing of alcohol upon digestion, we can only say that the question resolves itself into a question of "values." Is it worth while, for the sake of a fleeting pleasure, to take a substance which is continually urging glands to secrete and which delays the operation of digestion? Above all, can it be worth while to take a drug like alcohol which has ultimately such an injurious influence upon the nervous system, upon the liver, and upon tissue vitality as a whole?

IS ALCOHOL A FOOD?

"It is only lately we have begun to regard alcohol in its true light, as a drug and not as a food."—The late Sir SPENCER WELLS, Bart., M.D., F.R.S.

CHAPTER IX

IS ALCOHOL A FOOD?

So far as our present knowledge goes, substances we use as food act in several ways, viz.—

(1) In the providing of energy for muscular work.

(2) In the maintenance of the heat of the body.

(3) In the building up of the tissues.

(4) In the saving of waste of the tissues.

Moreover, a food must do no harm either to any organ or to the system as a whole, when taken in moderate but repeated quantities.

Definition of a Food

A food may be defined as :—Any substance which, when absorbed into the blood, will nourish, repair waste, and furnish force and heat to the body without causing injury to any of its parts, or loss of functional activity.

Chemically, it has been sought to define a foodstuff as something that is oxidised in the body, *i.e.* burnt up and disintegrated so that it is split up into component parts. This, however, cannot be

accepted as a proper definition of a food-stuff, because in addition to a capacity for being oxidised, a genuine food-stuff must be something that is of use to the economy in one of the four ways above stated, and it does not follow, because a substance is oxidised in the living tissues, that the results of such oxidation are of use to the body: on the contrary, many poisons are so oxidised. For instance, morphia and phosphorus are oxidised as far as possible by the tissues, the body striving to get rid of such poisons by the method of oxidation, just as in daily life we get rid of noxious materials by burning them on a rubbish heap.

We desire, therefore, to make it clear that the fact of a substance being burnt up in the body does not in the least entitle it to be called a "food."

All materials taken into the mouth may be classified under two headings:—

(1) Substances which are truly dietetic, *i.e.* which enter into the composition of the normal chemistry of the human organism.

(2) Substances which are non-dietetic, *i.e.* which do not enter into this normal composition.

From the point of view of dietetic use these latter materials have no value; on the contrary, their presence in the body tends to set up certain modifications in its chemistry, and thus to disturb the normal activity of the organs in a way that is undesirable. These substances have, of course, to be dealt with by

the tissues in some way or other, being generally oxidised so that they may be got rid of, this oxidation causing needless wear and tear to the tissues.

If now alcohol be examined according to the principles underlying the properties of a true food, we shall be able to assess its claim to be regarded either as a dietetic or non-dietetic substance.

1. **Provision of Bodily Energy.**—Alcohol has never been shown to produce energy for muscular work; in fact, the exact opposite is proven (see Chap. V. p. 125).

2. **Provision of Bodily Heat.**—It is sometimes asserted that because a certain amount of alcohol is oxidised in the organism it must therefore contribute to the warmth of the body. No doubt by its oxidation alcohol does contribute a very small amount to the body-heat, but the value of this is far outbalanced by the fact that alcohol causes a marked dissipation and loss of heat both by the skin (see Chap. VII.) and indirectly through its action on the nervous system.

But even if the heat which results from the combustion of alcohol were not thus more than neutralised, it would still be both foolish and extravagant to use as a fuel or source of heat anything which so markedly interferes with the well-being of the protoplasm of the body as a whole. As the *Lancet* points out with scientific eloquence:—

Sea-water may be used in the boiler of a steam-engine, and the steam from its evaporation will transmit the energy

of the fuel to the revolving wheels, but its corrosive action on the steel forbids its use except in emergencies.[1]

3. **The Building up of the Tissues.**—Ordinary food-stuffs, such as milk, bread, and meat, furnish the body with materials which, besides supplying storage capital, repair the daily wear and tear of the tissues, and may be regarded as genuine building materials.

Now alcohol does not possess this power of repairing tissue. Even ale,[2] although it contains sugar, has really practically no value as a nutritive or building material. Liebig, the renowned chemist, stated that "Nine quarts of the best ale contain as much nourishment as would lie on the end of a table knife."

When people put on weight as a consequence of taking alcoholic drinks, this increase is due to increase of fat and to delayed metabolism (see Chap. XIV.), not to any real nutritive value existing in the alcohol.

The popular belief that alcohol acts like a food is due to the fact that it allays the sensation of hunger. But it does this, not by acting as a food, but by its narcotic and soothing action on the brain, an action which is delusive and naturally to be avoided when

[1] *Lancet*, Oct. 22, 1904.

	Grains.	
[2] 1 pint Bass's pale ale contains	8284	Water 8284
	449	Alcohol 449
	400	Dextrine or gum—Sugar
		Albumens—a few grains only.

London porter, often asserted to be "nourishing," really contains less solids even than ale.

the support of good food is really required by the body (see also Chap. V.).

4. **Prevention of Tissue Waste.**—The problem as to whether alcohol may be regarded as saving the waste of the tissues has been frequently investigated; and, as the methods of science have improved, the experiments of Binz (1888), often quoted in favour of the value of alcohol in saving tissue waste, have been disproved. For instance, Romeyn, when he gave to starving individuals large doses of alcohol, observed on no occasion any diminution in the elimination of nitrogen (*i.e.* in the saving in tissue waste), but, on the contrary, in some cases there was a very decided increase. This means that the body waste was not saved but increased by alcohol.

In fact, it is strongly insisted on by those who have collated recent observations on this point that in tissues unaccustomed to the presence of alcohol its administration is almost invariably followed, for a short period at any rate, by increased nitrogenous waste.

We still need more knowledge on this difficult point; but the evidence as it stands shows that the taking of alcohol has no tendency to save tissue waste.

Chittenden endorses this position; and Muira, in a careful set of experiments on himself, came to the conclusion that alcohol had not any function as "albumin-saving," but, on the contrary, leads to increased nitrogenous waste.

This is ascribed to its direct poisonous action upon the tissues, for as soon as the alcohol is stopped the nitrogenous waste rapidly diminishes.

In small doses, and with the patient at rest and not taking food, there is some evidence to show that in certain cases tissue change is delayed by alcohol, but this can hardly be applied to ordinary active life, when food is being taken regularly.

To sum up, it is plain that alcohol cannot from any of these four points of view be regarded as a "food."

The truth is that the physiological effects of real food-stuffs on the one hand, and alcohol on the other, are totally different. Fats, carbohydrates and nitrogenous food after mastication, at once begin to be digested and assimilated, and to fulfil the true functions of a "food," by maintaining the natural temperature, pulse-rate, and tissue repair of the body without any disturbance of its mental and physical functions and activities. Alcohol, on the other hand, pursues a very different course. It is absorbed by the stomach unaltered by the digestive processes; circulating in the blood in its original form, it at once interferes with the ordinary activity of the brain and other organs, and by its anæsthetic action hampers our mental and physical activities. It further interferes with the metabolism (*i.e.* the living chemical processes) of the body, in such a marked manner that we have been obliged to set apart for

this portion of the subject Chapter XIII. to which the reader is referred for the completion of this discussion.

Meanwhile it will be agreed that it is unscientific to describe as a "food" any drug like alcohol, which so entirely fails to fulfil the functions of a food-stuff, or to come up to the standard of what we expect and obtain from genuine food, *i.e.* something which while being wholly innocuous in its effects on the body is also able to afford ample means of work production and of tissue growth.

THE LIVER AND KIDNEY

"More than three-fourths of the disorders in what we call 'fashionable life' arise from the use of alcohol."—The late Sir ANDREW CLARK, M.D., etc.

"Liver disorders are probably in all cases prejudicially influenced by alcoholic beverages. In kidney diseases alcohol should be withheld. Alcohol in moderate quantities irritates the kidneys."—Dr. J. M. WHYTE, *Edinburgh Medical Journal*, March 1901.

CHAPTER X

LIVER AND KIDNEY

To study the precise effect of alcohol on the living structure of a warm-blooded animal, with its complexity of organs and circulations of blood and of lymph, is so difficult that we naturally turn to such organs as are relatively simple in structure and are made of large masses of protoplasm (built up, of course, by innumerable cells or corpuscles).

In these we can see, by the microscope, what structural changes are taking place, and we can compare such with the disorders of function which they involve.

To take a separate organ for consideration always leads to one disadvantage, namely, that attention is apt to be concentrated on that particular one, whereas it is but one part of the body, and is merely an example of what is going on throughout the whole organism. With this prefatory warning, we will choose the liver and kidney as suitable for our purpose. We choose the liver, because in addition to being the largest gland in the body (weighing ~~4~~½

3

lbs.), and therefore permitting naked eye observation and study, it has other vastly important duties of storage and internal secretion, processes which are the basis of the normal metabolism and life of the individual. The kidney, too, readily permits of anatomical investigation, and is at the same time an example of a physiological function very different from that of the liver. It is part of the great excretory system, expelling in the urine all important chemical waste products of the body.

Structure of the Liver—Different Types of Liver Cells

The liver is the most important gland of the whole body. The thousands of cells of which it consists are engaged in working upon our food, partly in digesting it, partly in storing it, and changing it in various ways. Part of the duty of these cells is to secrete and pour out a fluid into the upper part of the intestine. This fluid is known as bile, and it is of great importance in the digestion of our food, especially of the fatty foods. Another part of the duty of these cells is to alter the starchy foods, and to store them up so that they can be used as they are wanted. It is important to the body, therefore, that the food should come into contact with the liver cells. This is brought about by the position of the liver being such that all nutriment absorbed by the stomach and intestines into the blood must pass through it. The blood-vessels which carry away

the products of digestion from the stomach and intestine, are gathered together from these organs into larger vessels, but when they reach the liver they break up into smaller and smaller branches, and these small vessels convey the blood containing the partially digested food material to the liver cells (Plate X.). But these small vessels are also built up of cells, and other cells accompany them to support them, so that the liver cells are not the only ones in the organ. Again, the bile, which, as we have seen, is produced by the liver cells, must be carried to the intestine. This is done by means of what are called bile ducts, and these too are formed of cells and supported by others. So that we see that in the liver there are three chief kinds of cells :—

(1) The liver cells proper.

(2) The cells lining the blood-vessels and the bile ducts.

(3) The cells supporting the whole and keeping it together—called fibrous tissue cells.

Action of Alcohol on the Liver.—Alcohol when taken in moderate amount is practically entirely absorbed by the stomach. That is to say, it is taken up by the blood-vessels of the stomach wall, and is in consequence carried straight to the liver. Therefore, as the first organ in the path of the absorbed alcohol, we should expect the liver to be most affected by it. We find that in many instances this is the case. Not only so, but the liver is also an excellent field for studying the action of alcohol

upon cells in general. It will, therefore, occupy more of our time than most of the other organs.

In considering the action of alcohol on the liver, we may divide the subject into:—

1. Its action on the blood-vessels.
2. Its action upon the liver cells.
   (*a*) on liver cells proper.
   (*b*) on fibrous tissue cells.

1. **Action on Blood - Vessels leading to Congestion of the whole Organ with Blood.**—The blood-vessels of the liver are (even by small doses of alcohol) quickly dilated, just as are those of the skin, the effect in the case of the liver being, however. much more marked, because that organ is so rich in large vessels. This engorgement of blood makes the organ heavier than normal ("Beer Drinker's Liver"), and causes also a slight stretching of its covering membrane or capsule, both of which conditions lead to a sense of local weight and discomfort. The sufferer is probably at a loss to explain why he or she feels so wretched, and it often never occurs to him to associate his sensations with his habit of taking alcohol. This condition of liver engorgement occurs chiefly in the early stages of the taking of alcohol.

2. **Action on Liver Cells.**—Before considering the action of alcohol upon the cells of the liver, let us recall what we have already learned about the action of alcohol upon cells in general (Chap. III.). It will be remembered that when we take such a cell as the

yeast cell and allow alcohol to act upon it, we find that its nutrition, its growth, and its power of reproduction are all interfered with. We have, in short, seen that alcohol is a cell poison.

Now, how does alcohol affect the liver cell? In the first place, we must distinguish between the different varieties of liver cells, and for our purpose it will be sufficient to divide these into two varieties, namely, the liver cells proper and the supporting or fibrous tissue cells. Why should this distinction be necessary? It is necessary, because although alcohol is a cell poison, it does not affect all cells in the same way. We have divided the cells of the body according to the work that they have to perform, but we may also divide them according as they behave under adverse circumstances. Now, just as there are some people in a nation who, from their mode of upbringing, are not fit for a rough life, and others who take to it naturally and thrive upon it, so there are some cells in the body which rapidly succumb to poisons, while others are even stimulated or irritated in such a way that they increase in numbers.

Action of Alcohol on the Liver Cell Proper

Let us take the first variety of cell which is found in the liver, the liver cell proper—the cell which secretes the bile and which stores the starchy food—and let us see how it is affected by such a poison as alcohol. Practically the effect is very much the same as the effect of other poisons, such as arsenic and

phosphorus. Usually it is not so great, because these are much more powerful poisons; still, when alcohol is taken in such large quantities as to cause death from "acute alcoholic poisoning," we find changes in the liver similar to those found in cases of phosphorous poisoning. The first change which the cells undergo is a swelling (cloudy swelling, Plate X.), which causes them to take up more room, so that the whole liver is enlarged. If the action of the poison is continued the protoplasm of the cell becomes transformed into globules of fat, this process being known as "fatty degeneration" (Plate X.). Needless to say that such a liver is incapable of performing the work which it ought to do. We see, therefore, that the liver cells belong to that group of cells in the body which are easily damaged by adverse conditions and to which alcohol is a true "cell poison."

Action of Alcohol on the Fibrous Tissue Cell

But now, turning to the other great group of cells in the liver—the fibrous tissue cells—we find that the effect of alcohol upon them is very different. They belong to the cells of the body which are not easily damaged, and a substance which will act as a poison to some of the other cells will simply irritate these cells and cause them to multiply. Now, of course, if alcohol is taken in very large quantities, so as to produce fatty degeneration of the liver cells, death occurs rapidly, and there is no time for any changes to occur in the fibrous tissue cells, or rather

PLATE X

Three microscopical sections of human liver (magnified 750 diameters), drawn by Dr. James Miller. The Normal Liver section shows four columns of liver cells, each with a round stained healthy nucleus, and separated by capillary blood-vessels containing blood which has come from the stomach and bowel. The red corpuscles and two white corpuscles (each distinguished by a stained nucleus) are shown on the blood-vessel. The specimen exhibiting Cloudy Swelling shows the same columns of liver cells swollen, their nuclei pale and beginning to shrink. The capacity of the blood-vessels is diminished by the swelling of the liver cells. The section of Fatty Liver represents the protoplasm of the liver corpuscles as containing numerous fat droplets which are gradually increasing in size.

To face p 238

PLATE X.

Normal.

Cloudy Swelling.

Fatty Degeneration.

J. M., *del.*

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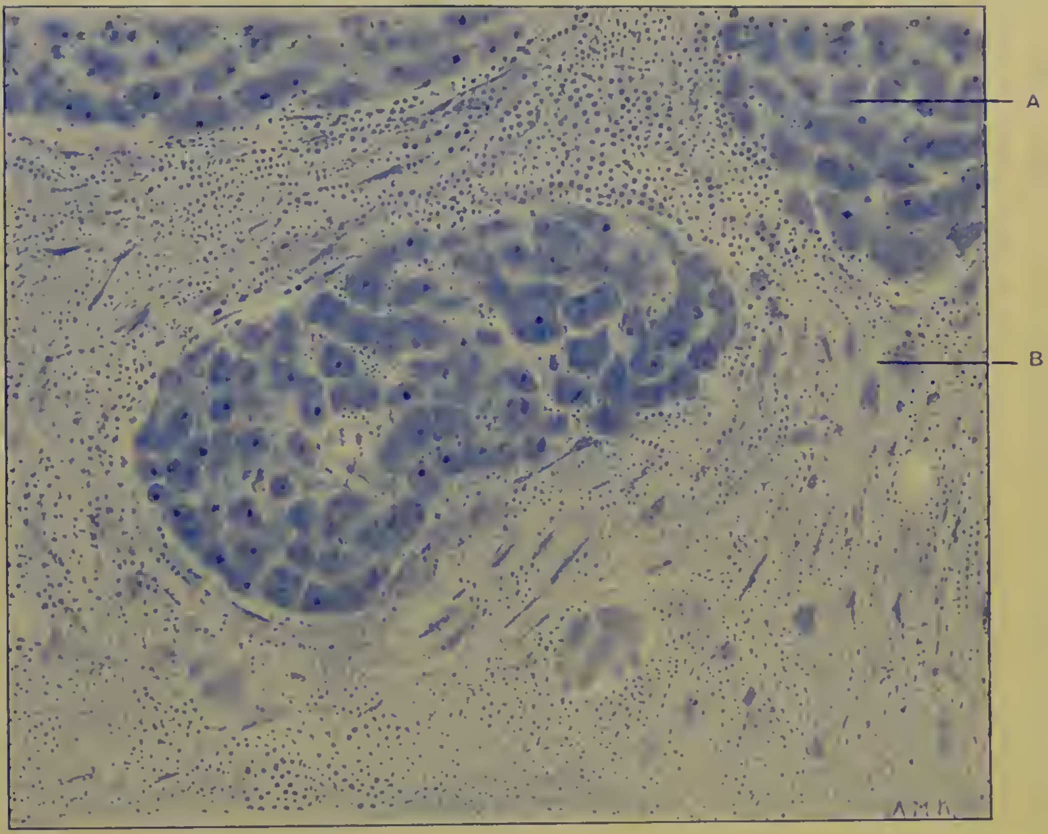
a—Nucleus of liver cell.
b—Nucleus of cell forming the wall of *c*.
c—A capillary blood-vessel.

l—Leucocyte or white blood corpuscle.
r—Red blood corpuscle.
f—Fat droplet.



A. M. Kelley, del.

Bale, Sons and Danielsson, Ltd

A—Liver-cell shrinking.

B—Connective tissue notably increased and separating the lobules of liver-cells.

To face p. 297.

PLATE XI

Microscopical section (magnified 125 diameters) from the liver shown in Plate XIII. It will be seen that instead of the whole section exhibiting liver cells arranged in healthy lobules, most of the picture is occupied by a highly corpusculated (? inflammatory) connective tissue, which by its scar-like contraction causes shrinkage and wasting of the liver cells.

the changes in them are quite unimportant. But when there are small quantities of alcohol frequently filtering through the liver, then we have an opportunity of seeing what changes occur in these cells. We find, then, that in such a case, partly because they are irritated by the alcohol, and partly because the gradual degeneration of the liver cells leaves them more room, these fibrous tissue cells multiply and increase in number. Now, if this irritant—alcohol—after being taken for only a short time, is removed, the condition of the liver will go back to what it was before irritation occurred; in other words, these new cells will disappear. But if the irritant be applied again and again, if there are constantly small quantities of alcohol filtering through the liver, then a time comes when these new cells settle down and develop into permanent fibrous tissue cells, forming what is known as "scar tissue," and the peculiarity of scar tissue is that it cannot be removed. We have seen that this new tissue partly takes the place of liver cells which have degenerated and disappeared, and, in addition, it also pushes aside and destroys other liver cells (Plate XI.). Hence it follows that not only are the liver cells which have to do the work more or less damaged, but in actual number they have diminished, and are replaced by useless scar tissue. A liver in this condition and also congested with blood is often enlarged and very unhealthy.

Drunkard's Liver

Moreover, another characteristic of scar tissue is that it tends to contract, *i.e.* to get smaller. This tendency on the part of scar tissue affects the liver structure as follows :—As a rule the scar tissue has been formed in patches and bands, especially round the blood-vessels where fibrous tissue exists normally. The contraction of these bands causes the liver to shrink, but this shrinking is only in places, so that portions are left projecting. Thus we have produced in severe and long-standing cases of alcoholism what is sometimes called the "drunkard's" or "hobnailed" liver, hobnailed because of the knob-like projections on its surface (Plate XIII.).

This contraction or shrinking of the liver still further presses upon the liver cells and interferes with the work they ought to do. It also presses upon and makes smaller the vessels which are carrying the blood through the liver; the watery part of the blood (which is able to travel forward at its proper rate) tends to ooze out of the blood-vessels before these reach the liver, and thus what is known as dropsy is produced.

Scar Tissue found in other Organs

What we have seen occurring in the liver occurs also in other tissues and organs of the body. We find this fibrous tissue everywhere—in the stomach, in the kidneys, in the arteries, and in the brain; the fact

PLATE XII

This figure shows the appearance of a healthy human liver viewed from the front and above. The larger lobe is the right, under it projects darkly the tip of the small gall-bladder in which a certain proportion of the bile collects. Compare this figure with the next. (Plate XIII.)

PLATE XIII

This figure shows the appearance of one form of alcoholic disease of the liver, namely, that in which the connective tissue increases and the liver cells degenerate and atrophy. This particular form is known as gin-drinker's or hobnail liver. Compare with the healthy liver shown in opposite Plate (XII.).

PLATE XII.

Bale, Sons and Danielsson, Ltd.

NORMAL LIVER.

A. M. Kelley, del.

To face p. 240.

PLATE XIII.

A. M. Kelley, del.

DRUNKARD'S LIVER.

Bale, Sons and Danielsson, Ltd.

To face p. 241.

being that this scar tissue is liable to be produced in all parts when there is present a constant irritation from alcohol, the normal cells of the structure being everywhere pushed aside. The general usefulness of an organ is thus seriously impaired, and there is a tendency for the circulation of the part to suffer.

Diseases of the Liver[1]

But in all this we have said nothing of the way in which these various changes in the liver affect the person himself. In the first place, interference with the amount and quality of the bile inevitably leads to indigestion and constipation, and a similar interference with the action of the liver cells and their chemical changes sets up in many cases gouty conditions, accompanied by mental depression or irritation. Swelling of the liver causes pain, discomfort, and sometimes jaundice; and contraction of this organ produces, as beforesaid, dropsy and swelling of the veins, in addition to symptoms which result from destruction of the liver cells. These symptoms are many and various, the liver being a most important organ and intimately associated with so many different bodily functions.

Diseases of the liver occur more frequently as a result of the frequent taking of small doses of alcohol (though never reaching the stage of intoxication) than as a result of indulging more freely but at intervals. Thus it comes about that publicans and

[1] For list see p. 296.

commercial travellers head the list of deaths from liver disease.

Note.—We have, of course, to remember that different people are affected in different ways by the action of alcohol. In some patients the nervous system succumbs quickly, whilst in others, in whom the nervous tissue is more resistant, the irritant action of the alcohol upon the liver has time wherein to manifest itself, and various disorders gradually arise.

The Kidney

It is not easy in a few words to describe the elaborate mechanism of the kidney, which consists of a filtering system of thousands of tubules arranged closely side by side, whose function it is to carry away from the body the waste material, which otherwise would interfere with the vitality of the different organs.

Suffice it to say that the part played by the kidney in rapidly eliminating effete material is a part that cannot be too carefully safe-guarded. Anything that interferes with its work will sooner or later cause retention of waste products in the system, and also will permit the escape of the valuable albuminous substances of the blood through the filtering apparatus.

Effect of Alcohol.—Such an effect alcohol, unfortunately, has upon the kidney, and to a degree that can only be described as disastrous. To those whose duty it is to investigate the medical causes of death, it is a matter of common observation that very characteristic changes are found in the kidneys of those who have habitually taken alcohol.

These changes are of the type already described in the previous section upon the liver.

They consist of:—

(1) Cloudy swelling.

(2) Fatty degeneration.

(3) Increase of fibrous tissue, followed by shrinkage of the kidney into what is known as the granular kidney.

All of these conditions seriously interfere with the work required of this important organ; and, as a consequence of its deficient action, the body becomes subject to numerous physical troubles, such as "rheumatic" pains, mental depression, loss of appetite, sickness, and other symptoms of impaired digestion.

The early appearance of albumin in the urine as a consequence of unsuspected alcoholism often leads to the refusal of an individual for life insurance without the causation of the condition being realised or properly dealt with by abstinence.

Later, the excretion of the urine is diminished in proportion as the kidney shrinks, and finally the condition known as chronic Bright's disease ensues, which ultimately ends fatally.

THE BLOOD

" Besides its deleterious influence on the nervous system and other important parts of our body, alcohol has a harmful action on the white blood-cells, the agents of natural defence against infective microbes."—Professor METCHNIKOFF, 1906.

CHAPTER XI

THE BLOOD

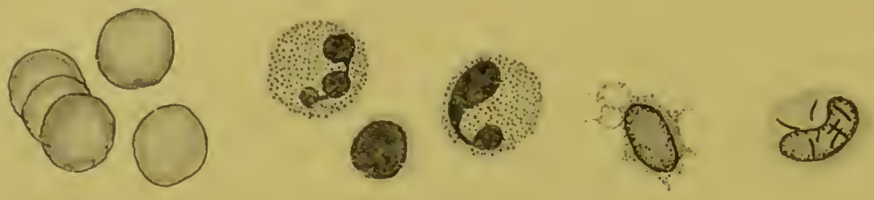
As previously stated, our bodies are built up of an immense number of units known as cells, each of which having its own duty to perform, leads in a certain sense an independent life. In order that this life may be carried on, the cell must be fed, must breathe, and must get rid of its waste products. As many of these cells are at long distances, relatively speaking, from the organs which take in food, absorb oxygen and excrete waste material, there must be provided channels of communication and some medium for carrying the food and oxygen to the tissues, and for bringing the waste materials to the kidneys, lungs. and skin, by which organs they are ejected from the body.

Such channels are found in the blood-vessels and lymphatic vessels, and such a medium is the blood itself.

The Blood.—The blood is a mixture of corpuscles and a fluid known as the blood plasma. The corpuscles are of two kinds, red and white.

Red Blood-Corpuscles

The red blood-corpuscles are very minute, flat, bi-concave (hollowed on each side) bodies (see Fig. 17), like coins, which, though appearing yellowish in colour when looked at singly, give the effect of being red when in masses. This colour of the blood is due to the presence in the corpuscles of a pigment or colouring matter known as hæmoglobin. This is the substance which seizes upon the



A B C D

FIG. 17.—Blood Corpuscles magnified 1000 diameters. The two kinds of blood corpuscles are here shown. The red corpuscles (A) have no nucleus; five are shown in a group on the left. The leucocytes, or white corpuscles, (B) have been stained, are granular, and exhibit nuclei which are either globular or exhibit forms of division. (C) Leucocyte, or white corpuscle, in the blood of a rabbit throwing out processes like an amœba. (D) Leucocyte containing several tubercle bacilli (the microbes of consumption), which it has taken up into itself, *i.e.* swallowed.

oxygen of the atmosphere when the blood is brought into contact with air in the lungs. The red blood-corpuscles are the carriers of the oxygen to the tissues, where they readily give it up. They are constantly being destroyed in the liver and spleen, and are replaced by new corpuscles which come from the red marrow of the bones. So minute is each corpuscle that it takes more than 3000 of them placed side by side to make a line one inch long.

White Blood-Corpuscles

The white corpuscles are much fewer in number, there being only about one of them to 500 red corpuscles. They vary in size and in appearance, but all contain nuclei, and are therefore true cells (see Fig. 17). In structure they are very like the amœba, and like it they are capable of altering their shape and of moving from place to place. Thus they can leave the blood-vessels and can travel through the tissues. Although so few in number compared with the red corpuscles, they have a very important function to perform. It is now about twenty years since the illustrious scientist, Professor Metchnikoff, of the Pasteur Institute, Paris, announced to the world his discovery that the white blood-corpuscles have the power of destroying the microbes to which so many of our diseases are due. These white blood-cells are the standing army or policemen of the body, and their duty is to attack and, if possible, to destroy any foreign matter, such as dust or disease germs, which may gain an entrance. They attack the germ by throwing out processes of their protoplasm, enclosing it and afterwards digesting it (Fig. 17). If microbes or chemical irritants are present in one particular part of the body, these white blood-cells leave the blood-vessels in the neighbourhood in large numbers and stream towards the point affected. They then attack the germs and seek to destroy

them. In so doing they are, many of them, in their turn destroyed, and their dead bodies, along with the fluids of the inflamed tissues, form "matter" or pus. A large collection of matter is called an abscess. Fresh white blood-corpuscles are constantly being manufactured in the bone-marrow, and when there are large numbers of organisms to be attacked, as in a disease like pneumonia, the bone-marrow produces them so rapidly that three or four times the normal number become present in the blood.

Blood Plasma

The liquid (or plasma) of the blood consists of water, albuminous substances, and salts. The salts are of various kinds, and include sodium chloride or common salt, also phosphates and chlorides of calcium and potassium. There are also small quantities of sugar and urea in the blood plasma. The sugar is there as a food, but the urea is one of the waste products thrown off by the cells of the body, and is carried by the blood to the kidneys, through which it is got rid of.

When blood is drawn off into a vessel it sets after a few minutes into a firm jelly or clot. The blood does not clot within the healthy blood-vessels, because these possess a perfectly smooth wall. If, however, the walls of the vessels become diseased, as is often the case in those who take alcohol (see Chap. XII.), clots may form and give rise to very serious symptoms, often even to the death of the individual.

The Blood Complement

In healthy blood plasma other substances may occur, one of which is known as the "blood complement." It appears that the presence of such chemical substances is probably essential in order that the white blood-cells may devour and digest disease-germs, for we find that when the germs (*i.e.* microbes) enter the body, these substances are produced in increasing amounts. Thus, if an animal or a human being be vaccinated or inoculated with a small dose of germs, these substances may be produced to such an extent that even a large subsequent dose of the same germs will do no harm. Such a process of vaccination or inoculation is called immunisation, and the animal or person so treated is found afterwards to be immune towards that particular germ.

Resistance to Disease

The way in which our bodies fight disease is, therefore, partly by means of the white blood-corpuscles, which actually devour the germs, and partly by the increase in the blood of these chemical substances, which are antidotes to the poisons given out by the germs. The reason why a disease like pneumonia comes to an end is that in undeteriorated tissues the white blood-corpuscles, aided by the substances in the plasma, get the better of the germ of pneumonia and the poisons which it produces.

Effect of Alcohol on the Blood as a whole.—Alcohol taken into the stomach is quickly absorbed, and in two minutes reaches the blood. The maximum quantity is found in the blood fifteen minutes after the dose is swallowed.[1]

We have seen that the blood is the medium by which food material, including oxygen, is brought to the cells in the various parts of the body, and that it is also the medium by which the waste materials resulting from cell activity are washed away. Now the presence of alcohol interferes with both these processes.

In the first place, the oxygen in the blood is prevented from properly reaching the tissues of the body. Consequently all the nutritional and building-up processes of the body are checked. As the red corpuscles are a living tissue, it is quite as probable that this hampering of the oxidation of the body is due as much to the effect of the drug on the blood-cells themselves as to its effect on the cells of the tissues to which the blood goes.

Secondly, as we describe in Chapter XIII., the elimination of waste products is seriously interfered with. This, again, is due to the presence of alcohol in the blood itself, as well as in the fluids bathing the tissue cells, which ought to supply these with nutriment and remove from them their waste products. Unaltered alcohol in the body-fluids, even in small quantities, exerts a paralysing influence on

[1] Gréhant, *Gazette medicale de Paris*, 1881.

the cells, rendering their powers of assimilation and excretion less rapid and less effective.

Detailed Effect of Alcohol on the individual Constituents of the Blood—(1) On Red Corpuscles.—Turning now to the detailed effect of alcohol upon the various constituents of the blood, we find, in the first place, that the red cells are liable to damage. Like ether and chloroform, alcohol tends to dissolve or change the superficial layer of these corpuscles which is of a fatty nature, and to damage the underlying structure of the cell.[1] The repetition of this damage leads ultimately to more or less anæmia,[2] which is recognised as a frequent accompaniment of alcohol-taking, and especially of alcoholic cirrhosis of the liver.

(2) **On White Corpuscles.**—Since the great discovery of Professor Metchnikoff, he and various workers have studied the influence of many substances, including alcohol, upon white corpuscles. From what we know of the action of alcohol upon cell activity in general (Chap. III.), it will readily be understood that its presence might damage the activity of these white blood-cells, and this indeed is shown to be the case. It is now proved that alcohol, even in tiny doses, paralyses more or less the white cells, which thus cease from exercising their microbe-destroying function. Speaking graphically, alcohol renders the

[1] Albrecht, *Verhandlungen der deutschen pathologischen Gesellschaft*, 1904, Heft 2.

[2] Naunyn, *ibid.*

white blood-cells less alert, so that they remain passive and motionless in the presence of dangerous microbes, which it is their duty to promptly destroy. Two Belgian observers, Massert and Bordet, in carrying out experiments on the attraction and repulsion of the living leucocytes by various bodies, found that alcohol, even in very dilute solution, strongly repelled leucocytes. Consequently, if alcohol even in very minute quantities is circulating in the blood, the leucocytes will not be able to make their way quickly into the blood, and thus be carried rapidly to any place where they are urgently needed. In consequence of this delay a severe illness frequently ensues: indeed, in the case of some microbes, these obtain such a strong foothold that the leucocytes never are able to drive them out. As Abbott has shown, this is particularly true of the microbe that causes erysipelas and cellulitis. The proneness of brewers and their draymen to suffer from these diseases is well known.

The seriousness of this adverse influence of alcohol upon the vigour and energy of the white blood-corpuscles cannot be over-estimated. Herein lies the explanation of many infections, many prolonged illnesses, much chronic ill-health, and many premature deaths.

(3) **On the Blood Complement.**—According to Professor Sims Woodhead,[1] "Abbot and Bergey find that in alcoholic poisoning these complements are irregu-

[1] *Recent Researches on the Action of Alcohol in Health and in Sickness*: a Lecture, by G. Sims Woodhead, M.A., M.D.

larly but distinctly reduced, and they maintain that this reduction accounts, first of all, for the impaired power of nutrition met with in alcoholised animals, on the ground that there are not sufficient complements to combine with the necessary nutrient proteid or albuminoid substances circulating in the blood. Moreover, the lack of these complements is of importance, from the fact that without them it appears to be impossible for any immunity to disease to be set up in an animal. They offer this as an explanation of the fact that in alcoholism impaired nutrition is first observed; and that this is accompanied or followed by an interference with the production of immunity."

THE EFFECT OF ALCOHOL UPON THE HEART AND THE CIRCULATION

"A falsehood which dies hard is the idea that stimulants of whatever kind actually give strength and are necessary for the maintenance of health and vigour. Such is not the case, and the well-worn comparison that they are the whip and spur and not the corn and grass is strictly accurate. Anything accomplished under the influence of stimulants is done at the expense of blood and tissue, and, if frequently repeated, at the expense of the constitution."—Sir W. Broadbent, M.D., K.C.V.O., LL.D., etc.

"Besides chloroform, alcohol may be mentioned as another drug which, while it renders the systolic output incomplete, increases the diastolic pressure and the dilatation of the heart."—Leonard Hill, M.B., *Text-Book of Physiology*, edited by E. A. Schäfer, LL.D., F.R.S., 1900.

"It has been shown, as well by experiments on animals as by observation on man during life and after death, that alcohol weakens the heart, causes hypertrophy and dilatation and fatty degeneration of the muscular fibres, and that it thus increases the natural tendency to failure of the heart which is usual in old age. Alcohol, by augmenting this tendency, adds to the danger arising from acute diseases, such as influenza and pneumonia, since persons with weak hearts much more readily succumb to such diseases than persons with strong hearts."—Sir Hermann Weber, M.D., F.R.C.P., *Alcohol and Old Age*, 1906.

CHAPTER XII

THE EFFECT OF ALCOHOL UPON THE HEART AND THE CIRCULATION

By the circulation we understand the driving of the fluid blood, round and round the body, through the blood-vessels, such driving being maintained by the pumping power of the heart, which is practically a hollow muscle.

In consequence of this pumping power of the heart, the blood in the vessels is under considerable pressure, which is naturally increased if the blood-vessel be narrowed or contracted, and diminished if the blood-vessel be expanded or dilated.

When studying the action of alcohol on the circulation, we have therefore, first, to consider its effect upon the action of the heart, and, secondly, its effect upon the blood-vessels of the body.

I. Effect of Alcohol upon the Pumping Power of the Heart

Popularly, alcohol is supposed to strengthen the pumping force of the heart; in fact, great faith was

placed in it on this account, until more recently, when the matter has undergone scientific revision and criticism. The question whether or no alcohol strengthens the force of the heart's beat is one of great practical importance, and with the improved methods of research at the disposal of scientific men, observations have been made with the view of ascertaining its real effect upon that organ. These investigations are too long and complex to describe here in detail, but we may state that experiments have shown that blood containing only one-quarter per cent of alcohol diminished within a single minute the work done by the heart; and that blood containing one-half per cent so seriously affected its working power that it was scarcely able to drive a sufficient amount of blood to supply its own nutrient arteries. This enfeebled condition rapidly leads on to dilatation of the heart, whereby "the heart pumps around less blood."[1]

The conclusions arrived at with regard to this local action of alcohol upon heart-muscle, may be summed up in the words of the writers of a recent and comprehensive review of the problem:—"It has yet to be proved that the heart-muscle can be stimulated by alcohol."[2]

[1] Martin and Stevens, *Studies from the Biological Laboratory of Johns Hopkins University*, 1889.

[2] *Alcohol and the Cardio-Vascular System*, by Dr. Munro, Physician to Glasgow Royal Infirmary and Professor of Medicine in St. Mungo's College; and Dr. J. W. Findlay, Assistant Physician to Glasgow Royal Infirmary.

Thus direct experiment upon the whole heart shows that alcohol has *not* the augmenting power formerly attributed to it, but that, on the contrary, it slowly depresses the action of the heart-muscle, and ultimately partly paralyses not the muscle only but also the delicate nerves which are present in the wall of the heart.

This paralysis of the cardiac nerves largely accounts for the acute dilatation of the heart and the fatal failure of that organ, which often occur when people have drunk large doses of alcoholic liquids.

Faintness

An objection may be raised that alcohol is used with success in the restoration of those who have fainted; and this matter may now be conveniently dealt with.

It must be borne in mind, in the giving of all remedies by mouth, that the mere act of swallowing or sipping accelerates the action of the heart, causing it to beat more quickly. Whether it be water or alcohol or simply saliva is immaterial as regards the value of this act of swallowing, which reflexly tends to relieve the heart. Therefore our first effort with a fainting or exhausted person is to induce them to swallow or sip something—and if possible a liquid that is warm.

Alcohol, when given, acts as an irritant (so-called stimulant) to the nerves of the mouth and stomach, causing a preliminary excitation of the nervous

system, and it is to this that the apparent revival is due. Other substances have this power of stimulating the nerves in the same way, for instance, a burnt feather, ammonia, ether. A side issue in the case is the fact that alcohol causes dilatation of the blood-vessels of the body owing to its depressant action on the nerves that control these blood-vessels (see Chap. VII.), and this relaxation induced by alcohol permits the passage of blood to occur more readily than normal, and, therefore, for the moment the heart turgidity may be relieved and its work be accomplished with less effort. Thus far alcohol may indirectly be of a little value, but, as we have stated above, the proofs of actual heart stimulation are wanting.

The best thing to do in a case of fainting is to lay the patient flat near open windows, to loosen all clothing, and to raise the feet if recovery be slow. Sips of water, preferably hot, should be given, and as the patient revives hot milk should be sipped, as this will be found to be both stimulating and nourishing.

These facts are in undoubted opposition to the almost invariable practice of giving alcohol, in the belief that it improves the tone of the heart and its circulation—but, as has just been shown, the ideas on which such use of alcohol is based have now been found to be incorrect.

This notable development of clinical opinion is strikingly exemplified by the extraordinary reduction of the amount of alcohol given in hospitals, and by

the successful issue of cases treated entirely without it.

A glance at the chart opposite p. 6 will at once indicate the way in which medical treatment has completely altered in regard to the prescribing of alcohol. It is no longer given by physicians and surgeons as a routine and serviceable remedy required to help the heart and digestion, although some practitioners still permit a certain amount to be taken when patients state that they are dependent upon its habitual use.

Effect of Alcohol in conditions of "Shock"

A most striking proof that alcohol is not only of no service in the restoration of the heart's action, but that it is distinctly depressant, is exemplified by the treatment of cases of "shock." Crile[1] has shown by direct experiment on the state known as "shock" that alcohol only aggravates the conditions resulting therefrom; and wider experience has demonstrated that hypodermic injections of strychnine and atropine, and the use of other substances,[2] are far better calculated to bring the patient out of danger than the alcohol, so often given as a routine, while other far more valuable remedies are omitted.

As regards this change in medical practice, it must be remembered that our forefathers had not discovered the value of hypodermic injections, and their remarkably rapid and certain effect. In modern methods of

[1] *Blood-Pressure in Surgery*, by George W. Crile, A.M., M.D.

[2] Notably the subcutaneous injection of large amounts of water.

treatment reliance is always placed upon the above-named drugs in cases of danger, few dreaming of depending on alcohol.

Alcohol and Chronic Disease

Similarly in chronic disease alcohol has been shown to be of no real benefit in the way of stimulating the heart—its action under such circumstances being more that of a narcotic and sedative. Not a few persons, especially the aged, suffering from some chronic ailment, have been rendered bedridden, and have lost all disposition and ability to move about, as a result of this mistaken use of alcohol.

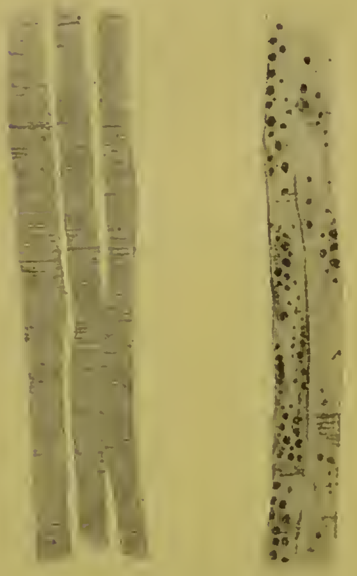


FIG. 18.—Two drawings of muscle-fibres from the heart and magnified 375 diameters. The regularly striated muscle-fibres on the left hand are healthy. The fibres on the right have almost entirely lost their striation, and their substance is infiltrated with droplets of fat which have been stained black. Thus the fibres are in an active state of fatty degeneration. This diseased specimen is taken from a patient suffering from chronic alcoholism.

In fact, alcohol acts as a direct poison on the protoplasm of heart-muscle just in the same way as chloroform and diphtheria, and as a result there occurs slight swelling and cloudiness of the muscle-fibre, and later on the actual deposition of droplets of fat in the fibre itself. Fig. 18 shows the difference between a

normal fibre and that rendered flabby by containing deposits of fat. A heart thus weakened tends to dilate, and this common and serious condition we must now consider.

Dilatation of the Heart

Dilatation of the heart due to alcoholism may be either:

(1) Gradual in its occurrence,—or,

(2) Sudden and fatal.

1. **Gradual dilatation** or stretching of the relaxed muscle is a very common condition, and the part played by alcohol in its causation may be explained as follows:—

The depressing effect of alcohol upon the nerves which control the action of the heart, the hampering effect of deposits of fat on and between the muscles, and finally the impaired power of contraction possessed by the muscle-fibres themselves when they are beginning to undergo fatty degeneration, unite in causing a weakened power of contraction of the heart, which consequently fails to empty itself completely when it strives to pump forward its contents. Such a languid and ineffectual method of contraction leads gradually to a slight stretching of the heart, this being for the moment the most ready way of accommodating itself to the increased internal pressure caused by overfulness. From this point matters tend to become worse, unless the factors which encourage dilatation are removed from the patient's life. For not only

does a dilated heart fail to empty itself properly, and hence become increasingly hampered by its own over-fulness, but the whole circulation through the body is hindered, to the great detriment of all the organs. This condition is one of extreme importance, because owing to the special situation of the abdominal organs and the arrangement of their circulation, the liver, spleen, stomach, etc., become venously congested directly the heart flags in its duty of keeping the circulation active. There is, in fact, an accumulative or back-flow effect, which tells immediately and primarily on the liver. But this is not all: for any marked weakening of the force and strength of the heart leads at once to a slowing of the circulation, and thus to a partial stagnation of the blood all over the body. Consequently the tissues are deprived of the rapidly changing supply of nourishing blood which they need; and as a result of this semi-starvation they naturally deteriorate.

This partial starvation occurs also in the tissues of the heart itself, and is a most serious thing, considered in the light of the stupendous task which that organ has to perform throughout life, a task which it can only accomplish satisfactorily as long as its blood supply is perfect and its muscles nourished.

2. **Acute dilatation** occurs not infrequently in those whose heart-muscle has been for years somewhat undermined by alcohol and other indulgences. A fatty and dilated heart requires but little stress (such, for instance, as a mild attack of illness or an attack of

indigestion) to make it dilate suddenly and even fatally.

Gradual Deterioration in Heart Power a Cause of Premature Death

One of the early indications that the foregoing changes may be occurring in a heart is a sense of fatigue and breathlessness on slight exertion, or a feeling of disinclination for normal effort.

For instance, those who have taken alcohol in small quantities for years often notice in themselves an absence of energy, and their vigour and freshness return only after a few months of total abstinence, during which time the heart gradually regains its tone. It is probably not realised by many that very small doses, constantly taken, ultimately cause an effect on the heart. The result of such depression of the efficiency of the heart with many is that when they are attacked by some disease they succumb to heart failure, instead of being able to hold their own and recover from the illness. This probably accounts for the great number of deaths in men between forty and sixty years of age, men who ought to live to a good old age, but who are heavily handicapped when a disease such as influenza or pneumonia comes upon them, their hearts being below par. This loss to the community is incalculable. So serious is it, and so needless, that in considering matters of national physical efficiency it ought not to be ignored. A man of forty to sixty should be of real value to his

country, whether as a work producer or a teacher or thinker—his powers of body and mind being at their best. Too often are these powers impaired, and the normal resistance to disease and death lessened, by what is often regarded as an ordinary dietetic use of alcohol. When the death of a man in the prime of life is announced, the first thought ought to be: "Need he have died?" In the large majority of these cases, a little investigation will show that what should have been a normally resisting heart has been weakened by daily habits and social customs.

On the other hand, it is happily an everyday experience to hear of a patient recovering from a severe illness mainly because of his temperate life. In other words, his organs, especially his heart, are in a healthy state, and thus enabled to combat disease successfully.

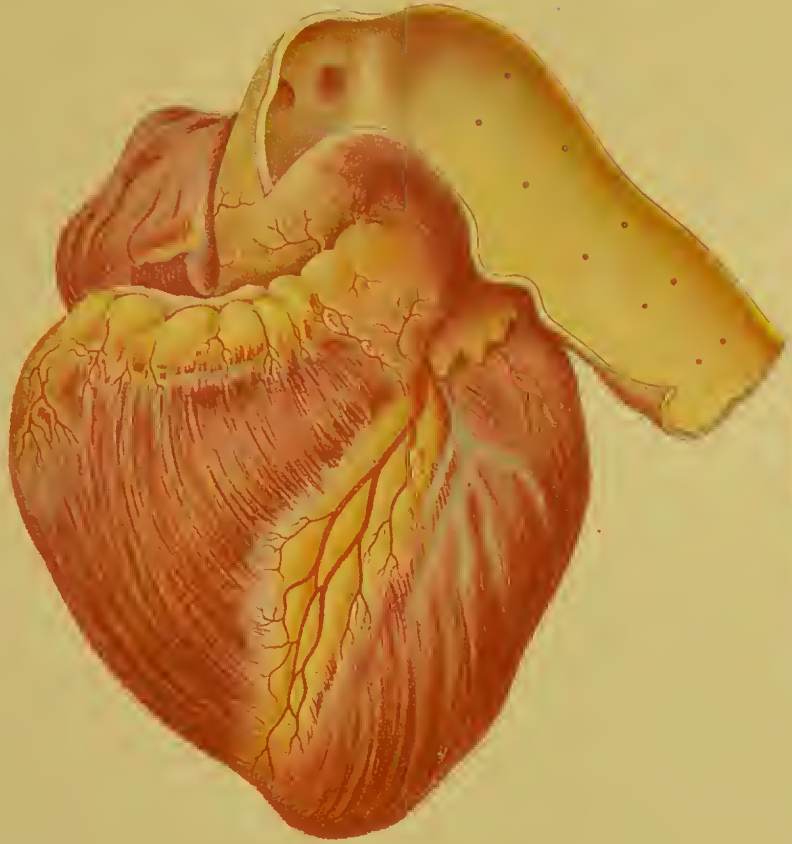
Beer-Drinker's Heart.—This term is one well known to the physicians of our large hospitals, and indicates a special condition of unhealthy enlargement of the heart due to dilatation, accompanied by some increase of tissue and of fat. Doctors Bauer and Bollinger found that in Munich one in every sixteen of the hospital patients died from this disorder. It is common in Germany—the land of beer-drinking—and proves incontestably that the habit of drinking even such a mild alcoholic beverage as "lager beer" is one that is undesirable and unwise.

PLATE XIV

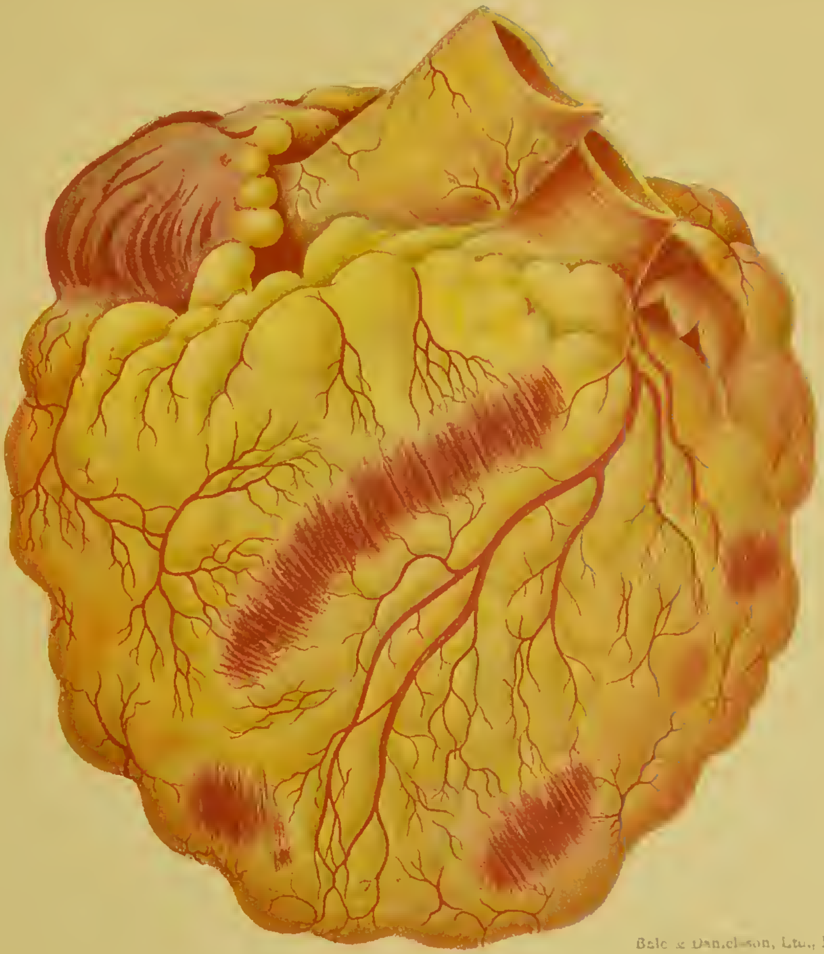
Two drawings of the human heart rather more than half the natural size. The smaller one on the left (Fig. 1) is a healthy specimen, the larger on the right (Fig. 2) is a fatty and dilated heart from a beer-drinker. These very accurate representations are copies of drawings by Dr. C. Henning from preparations by Professor Weichselbaum, and are reproduced by kind permission of the Austrian Anti-Alcohol Society. The muscular substance of the beer-drinker's heart is not only itself fattily degenerated, but it is greatly overlaid and hampered by the overgrowth of fat which, as is well shown in the figure, is but a gross exaggeration of what exists to a moderate degree in health.

To face p. 26

PLATE XIV



NORMAL HEART



FATTY ALCOHOLIC HEART

Bale & Danielsson, Ltd., Lith.

II. Effect of Alcohol on the Blood-Vessels

1. **Chronic Congestion.**—When alcohol is swallowed it produces, as we have seen, a local effect on the blood-vessels of the stomach (p. 196), and almost simultaneously causes dilatation of the blood-vessels of the liver, which organ becomes turgid and swollen. The same condition obtains (as soon as alcohol reaches them) in the other organs of the body, their vessels becoming dilated—whether by local or reflex action is not determined, but probably by both agencies.

Repeated doses of alcohol, of course, render this dilatation of vessels more and more permanent, and as the flow of blood through the widened channels is necessarily slower (especially in view of the impaired action of the heart), a condition of stagnation, or what is called chronic congestion, ensues.

The bluish appearances of skin in people who take much alcohol is thus produced; and it is not surprising that before actual disease of the kidneys and other organs sets in, this chronic congestion leads (for example) to such a condition as albuminuria—that is to say, to the escape of the extremely important albuminous constituents of the blood into the water which passes away from the kidneys.

Moreover, as soon as a state of chronic congestion is established in any part, the delicate chemical changes between the blood and the tissues nourished by it are so seriously interfered with that the tissue begins to undergo the first stages of fatty degeneration.

2. **Alteration in the Walls of the Blood-Vessels.**—Dilatation of vessels and consequent congestion is not the only alteration induced by alcohol in the thousands of blood-vessels which penetrate every part of the body. A most important change takes place in the actual walls of the blood-vessels, *i.e.* a degeneration of these walls which occurs as the direct result of the constant taking of alcohol.

For many years it has been known that a thickening occurs in the walls of the blood-vessels of many persons. Microscopically this change is shown to be due to an increase of the normal fibrous tissue existing in this position, and in some cases there is found to be accompanying it a condition of fatty degeneration, and also even of calcification of the vessel-wall (pipe-stem vessels).

Recent observations have convinced most thoughtful observers that this condition of vessel-wall, "in certain cases at any rate, can be attributed to nothing but the use of alcohol, and not always or necessarily in very large doses."[1]

This fibroid thickening leads to a lack of elasticity and contractility in the vessel-walls, and therefore to a delay in the blood-current, and to a stagnation or stasis of circulation.

In consequence of this a much greater amount of work is thrown upon the heart, which therefore is obliged to use up its reserve power and energy.

Interference with Nutrition.—It must be remem-

[1] Professor Sims Woodhead, *The Practitioner*, November 1902.

bered that all the nutritive action of the blood depends on its power of filtering rapidly through the walls of the blood-vessels to the tissues,—and, conversely, its power of drawing off the waste products of the tissue depends on the facility and readiness with which such products can penetrate the walls of these vessels.

As soon as degeneracy sets in the walls of all the vessels tend to become thickened, and the active transference of liquid through them being more or less prevented, the nutrition of the body is gravely hampered.

This process of thickening in some people is very slow, in others it is rapid. As it advances, the vessels become not only less able to adjust themselves to the constant variation of the pressure of the blood within them, but finally unable to withstand that pressure. They therefore frequently rupture and produce hæmorrhages and apoplexies, which, when occurring in the brain, cause paralysis and mental decay.

Of course a similar degeneration takes place not infrequently in old people, but the immediate point is that many persons, instead of waiting until old age comes to them, deliberately bring upon themselves this change in their blood-vessels, with its consequent risk of apoplexy and early loss of brain vigour (to say nothing of the early failure of other organs), by taking alcohol in what is often termed "moderation."

THE EFFECT OF ALCOHOL ON THE METABOLISM OF THE BODY, AND UPON THE POWER OF THE LATTER TO RESIST DISEASE

"Ἄριστον μὲν ὕδωρ." "Water is the best."

"It was formerly thought that alcohol was in some way antagonistic to tuberculous disease, but the observations of late years indicate clearly that the reverse is the case, and that chronic drinkers are much more liable to both acute and pulmonary tuberculosis."—Professor OSLER, *Principles and Practice of Medicine.*

"Every medical man or woman is painfully conscious of the fact that not only are innumerable diseases aggravated, but many diseases actually engendered, by the habitual daily indulgence in alcohol, even within the limits of temperance.

"There is no disguising the fact that the habitual daily indulgence in alcoholic drinks tends notably to weaken the constitution of most persons, and predisposes hereditarily feeble tissues to undergo *prematurely* the cellular and fibroid forms of *tissue degeneration.*

"For every real drunkard, there are fifty others suffering from the effects of alcohol."—GEORGE HARLEY, M.D.

CHAPTER XIII

THE EFFECT OF ALCOHOL ON THE METABOLISM OF THE BODY, AND UPON THE POWER OF THE LATTER TO RESIST DISEASE

The Metabolism of the Body as affected by Alcohol

Metabolism.—Poisons in general being chemical substances tend to exert a delaying or *inhibitory* influence over the chemical processes of the body, which processes must go on unhindered if the body is to carry on its functions usefully; in fact, the very expression "living" implies that nothing should be allowed to occur which even in the smallest degree interferes with the chemical processes of the tissues. These consist of:—

(1) Oxidation.
(2) The storing up of nutriment.
(3) The manufacture of secretion.
(4) The production of energy and muscular movement.
(5) The excretion of waste material—

all of which processes form the respective duties of the component cells of the tissues of our body.

These chemical processes in their entirety are spoken of as metabolic; and this word in its convenient form of "metabolism" is used to denote the normal healthy chemical changes going on in the body as a whole.

Such changes are twofold :—

(1) *Constructive*, or building up, in which substances combine with the protoplasm of the cells, helping in its renewal, and in the general building up of the tissues and juices of the body.

(2) *Destructive*, or breaking down, whereby the protoplasm by combining with oxygen, and thereby liberating heat and energy, breaks down into less complex substances, *e.g.*

Water—Carbonic Acid—Urea, etc.

These two latter are waste products, and require rapid elimination from the body if health is to be maintained.

We speak of an "active metabolism" as occurring when the different parts of the body are each working well and effectively in the two ways mentioned, there being no feebleness or delay or irregularity in the performance by the tissues of their various functions and in the execution of their chemical processes.

Water.—Throughout the whole of Nature, water plays a remarkable part in facilitating chemical changes; indeed, its presence is absolutely essential to

many of these. Thus iron will not rust, *i.e.* oxidise, if it and the air it is exposed to be chemically clean and dry. So also nitric acid and copper which combine with such avidity, fail to do so if water (if only in traces) be not present. So with the body, water is all-important for its healthy and active metabolism of the tissues, which, in fact, in their ultimate composition consist of at least three-parts of water. Water, in fact, acts as a middleman. Its molecules are readily taken up by many a compound, which after this junction with water can then be split up into much less complex substances which are more soluble and more easily excreted. Thus, that most vital part of our metabolism, namely, the getting rid of waste products, or the free flushing of the tissues with water, is not only a mere popular expression, but has a definite basis in fact. Children with their very notable activity of body naturally drink much water. In this they are only complying with a normal physiological necessity.

The ideal physiological material is water. This cannot be properly supplied by alcoholic drinks, which indeed have their own adverse effects as well.

Oxidation. — One of the main metabolic changes continually occurring in the body is that of oxidation of the tissues. The blood as it passes through the lungs takes up a supply of oxygen from the air and conveys it to the muscles and tissues of the body. There, in a complex way, which as yet is not entirely understood, the oxygen combines with the protoplasm

of the cells or corpuscles of the body, and as a result of this chemical combination heat and energy are evolved, and carbonic acid gas is formed. This latter is taken up by the blood-stream, conveyed to the lungs, and there eliminated by being breathed out into the air, other waste products meantime being passed off by the kidneys or by the bowel.

Various Materials oxidised by Oxygen

In the laboratory of the human body, oxygen meets with various types of oxidisable material: food-stuffs are oxidised; the waste matter due to tissue growth and repair is partially oxidised; foreign matter and poisons are oxidised, and in each case heat is liberated.

During active and healthy metabolism this process of oxidation goes on rapidly. It is the means whereby bodily heat and energy are provided, and all effete, waste, and poisonous materials, which otherwise would clog the body, are got rid of.

Now the term "oxidation" must in no way be confined to what occurs when food-stuffs are oxidised and heat and energy liberated, although some writers are inclined thus to limit its use. In reality "oxidation" means much more, *i.e.* that in addition to the combustion of food-stuffs, waste products and worn-out protoplasmic molecules are being partially burnt up prior to removal from the body. This combustion of waste products may be aptly compared to the burning of rubbish on a fire, in which case the oxida-

tion and consequent destruction are much more effective when a full supply of air laden with oxygen is admitted to the slowly burning mass. It is by this method of oxidation that poisons themselves are frequently broken up, and thereby robbed of their harmful qualities.

The greatest possible difference exists as to the rate at which oxidation goes on. When there is nothing to hinder its occurrence, the poisonous toxines and waste matters which form in our bodies, are rapidly burnt up and eliminated, and health prevails. On the other hand, when various things interfere with oxidation, our vitality and vigour become necessarily impaired.

Alcohol a Cause of Deficient Oxidation of Tissue.—From what has been stated, it is clear that anything which interferes with the process of oxidation is to be regretted, as tending to delay the normal elimination of waste material. Now, unfortunately, alcohol is admitted to have this effect. It possesses an affinity for oxygen, and has long been considered to have the power of interfering with and lessening the oxidation of albuminous material, this power being explained on the theory that it robs the tissues of the oxygen which they would otherwise use for combustion.

When alcohol is present the tissues are kept starving for their oxygen, hence their normal rate of metabolism or tissue combustion is delayed, and they cannot get rid of their waste material in the way they require. Thus the body becomes

elogged and irritated by the presenee of many effete substanees which ought to have been eliminated had oxidation not been interfered with. As a eonsequenee of this, ill-health of various degrees is liable to oeeur.

At one time, under certain conditions of disease, this delay in tissue waste (*e.g.* in metabolism) was supposed to be advantageous, and, therefore, alcohol was given freely; but modern medical thought is in favour of the direct supply of oxygen to the tissues, rather than of prescribing alcohol in order to limit oxidation. By this modern and more scientific method, the elimination of the morbid products due to illness occurs far more rapidly than under the alcohol method of treatment, and recovery is often less protracted.

Increase in Body Weight due to Delayed Oxidation

The delay in oxidation, and therefore in metabolism generally, indueed by aleohol, tends to cause an increase of body weight.

This is aeeounted for readily. The eells of the body are eonstantly wearing out and are replaced by new ones, many of those that are useless becoming fatty, as an intermediate stage before being finally oxidised and burnt up.

Now, when there is any defieiency of oxygen in the tissues, the further eombustion of such eells as have reaehed the fatty stage is delayed for lack of oxygen. In this intermediate stage of fatty degeneration they clog the body, and, of course, add

to its volume, such addition being far from a gain to the system.

The tissues of many persons who take alcohol are in this state of delayed oxidation. When, however, such persons change their habits and abstain from its use, their bodily processes gradually quicken and improve; the superfluous tissue is often slowly burnt away; their weight frequently becomes reduced; and they recover a look and feeling of youth and vigour which they had lost.

The increase of fat already alluded to is accompanied by a striking distension or swelling of the cells in which it occurs. Cells that were originally and in their natural state small and flat, become distended with fat and oily particles, until they are stretched and dilated to five or six times their normal size. (See Plate X.)

Thus the gradual effect of taking alcohol is to make the body "obese." In this condition it naturally becomes increasingly disinclined for exercise, and actually unable to take it, or to lead the active useful life required by health. Muscular movements are liable to be slower and more sluggish than they ought to be—slower, that is, than in persons of the same age who are abstainers.

Alcohol a Cause of Premature Old Age

The characteristic of alcohol is that it causes a gradual waning of the metabolic activities of the body, this waning being frequently so gradual that people are

often totally unaware of the fact of its occurrence or that it is due to alcohol. If they think about the matter at all, they attribute their increase of weight, their shortness of breath, and their lack of energy to the advance of age, being quite unaware that their "middle age" is accelerated by the use of alcohol, and, consequently, that their term of life is really being shortened.

Are Small Quantities of Alcohol disposed of without injury to the Body?

The statement is not infrequently made that a small quantity of alcohol can be got rid of by the tissues without any harm resulting to them. In fact, it is customary to say that an extremely small quantity can be oxidised and in this way "burnt off" (to use a popular chemical expression) without any traces of the reaction having occurred. But this is tantamount to saying that a machine can work without wear—a proposition which is contrary to the known facts of physics and chemistry. From a chemical point of view it is, in fact, impossible to say that the habitual use of alcohol is without effect on the metabolism of the body. We have already seen that modern methods of investigation show fully that in the case of the nervous system the use of alcohol, even in small quantities, has an effect which is definite and deleterious (see Chaps. V. and VI.); and the evidence that is accumulating with regard to metabolism as it

occurs in the other organs all points in the same direction.

Destiny of Alcohol in the Body.—Scientific men have spent much time and energy in striving to discover whether or no all the alcohol taken is oxidised in the tissues. The matter is still under debate, but the evidence points to the fact that when very small quantities are consumed, 95 per cent may be oxidised in the body, just like morphine and other extraneous substances.

With increasing quantities of alcohol, however, this oxidation occurs less completely, and a considerable amount of alcohol is then eliminated as such by the kidneys and by the lungs.

Alcohol a Source of Heat, but an Undesirable Source

Any oxidation of alcohol which occurs in the tissues produces, of course, its equivalent in heat, but so does the oxidation of any poison. Professor Schäfer, in his latest text-book on physiology, says: "It cannot, in fact, be doubted that any small production of energy resulting from the oxidation of alcohol is more than counterbalanced by its deleterious influence as a drug upon the tissue elements, and especially upon those of the nervous system."[1]

The Influence of Alcohol on the Temperature of the Body

The temperature of the body, which is artificially maintained by the processes of life at a level

[1] *Text-book of Physiology*, by A. E. Schäfer, F.R.S., M.D.

above that of the surrounding atmosphere, is kept up by the oxidation which occurs in the tissues, and especially, of course, by the oxidation in the muscles. The control of this production of heat in the body is maintained by the nervous system.

The fact is now firmly established that alcohol causes a lowering of the temperature of the body, and that this occurs in spite of the deceptive subjective feeling of warmth experienced by the person who takes the alcohol. This fall of temperature is largely due to the loss of heat from the surface (Chap. VII.), but a certain amount of it should be ascribed to the diminution in the metabolic activity of the tissues, caused by the injurious influence of alcohol over their chemical activities. Less chemical action takes place, and therefore less total heat is evolved. The same thing occurs as a result of taking ether or chloroform.

Altered Metabolism leads to Defective Activity of Certain Glands

The lowered functional activity of certain glands of the body may sometimes be clearly traced to the influence of alcohol. We may instance two examples found in women, *i.e.*

(1) Defective lactation.

(2) Defective ovulation.

Defective lactation is of such crucial importance to the community that we have discussed it in detail in

Chapter XV. Defective ovulation, leading as it does to sterility in women, is a condition that is recognised as being sometimes due to alcohol. Its bearings upon the important question of "birth-rate" cannot be neglected in a country needing good citizens, and in France the subject is receiving definite attention.

Altered Metabolism leads to Disease from Within

Many conditions of ill-health are due to a wrong state of metabolism, brought on by nothing else but error in food and drink. For instance, "gout" is a disease due to faulty metabolism, and it is now acknowledged that alcohol is a prime factor in causing such conditions as gout, eczema, headache, lumbago, certain neuralgic pains, etc., inasmuch as it interferes with the needful formation and elimination of waste matters, in other words, interferes with the "metabolism" of the body.

Glycosuria is another condition of ill-health closely associated with faulty metabolism. Certain authorities connect its onset and persistence with alcoholism. Thus Dr. Saundby says—

> "It is among elderly diabetics that alcohol plays an important part, and probably many of these cases could be cured if we were able to check the habit upon which the persistence of the glycosuria depends." [1]

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[1] "A Further Note on Alcoholism in Relation to Glycosuria and Diabetes," *Birmingham Med. Review*, September 1902.

Altered Metabolism leads to a Diminished Power of Resistance to the Invasion of Disease from Without and delays the Healing of Wounds

The most important result in relation to this matter of general degeneration and disturbance of the metabolism of the body by alcohol, is the fact that the tissues of persons who take alcohol are less able to resist disease. Moreover, their wounds heal less quickly than the wounds of those who do not take alcohol.

In the first place, as regards the better healing of wounds in persons who are abstainers, the reason is obvious. The protoplasm of their tissues is not degenerated, and it has a capacity for growth whereby the desired union of the edges of the wound is effected. Numbers of patients accustomed to taking alcohol are obliged to make a protracted stay in hospital on account of the slow healing of wounds, which, had their tissues been in a normal condition, would have united rapidly.[1] Many others are warned by surgeons that their healing power is likely to be bad unless they abstain from alcohol before operation.

As regards resistance to disease, Professor Welch,[2] the distinguished American pathologist, says :—

[1] Kreparsky (*Presse Med.*, July 20, 1898) has shown that alcoholism, acute or chronic, lessens the number of white cells, and that the repair of wounds takes place more slowly in drinkers, because of the insufficient supply of white blood-corpuscles at the area undergoing healing.

[2] *Physiological Aspect of the Liquor Problem.*

"This lowered resistance is manifested both by increased liability to contract the disease and by the greater severity of the disease."

In the case of illnesses such as pneumonia and blood-poisoning, which are caused by microbes now thoroughly well known and identified, it is proved that the alcoholic habit notably diminishes the power of the tissues to resist the invasion by these same organisms (for the reason of this see Chap. XI.). It is a recognised clinical fact that a drinker is less resistant than he should be to attacks of cholera, intermittent fever, consumption, pneumonia, and blood-poisoning in all its forms, such as erysipelas, syphilis, etc. During the cholera epidemic in Glasgow in 1848-9, Adams observed 225 cases, and found a death-rate of 19·2 per cent among abstainers, and 91·2 per cent among those addicted to the use of alcohol. Experience in other parts of Europe and America have confirmed these observations.

Pneumonia.—With regard to pneumonia, it is now accepted that any routine treatment with alcohol involves grave risks. Dr. Muirhead, of Edinburgh, pointed out years ago that the death of a case of pneumonia uncomplicated by alcoholism was of the rarest occurrence, and that patients recovered without its use medicinally. Even when this disease is complicated by influenza, there are not wanting physicians of experience who triumphantly "pull their patients through" by means of drugs other than alcohol, which, indeed, they regard as especially

deleterious in cases already suffering from influenzal poisoning.

It is important here to explain briefly the twofold way in which alcohol renders the lungs liable to disease. First, let it be remembered that persons with whom its use is habitual are more liable than others to an irritation of the mucous membrane of the throat, which they are always attempting to "clear." This is not in itself dangerous, but when a similar condition of catarrh supervenes in the large tubes of the lungs, the healthy condition of these disappears, and the patient becomes more liable to bronchitis and to infection by the germs of tubercle and pneumonia.

Secondly, the repeated taking of alcohol leads to a dilatation of the blood-vessels of the lung, and these vessels being extremely numerous, a tendency to congestion occurs. Lungs in this condition of incipient congestion are readily affected by climatic falls of temperature, and by the presence of bacteria, and the outlook when such lungs become actively diseased is proportionately serious.

Consumption, or Tuberculosis.—The susceptibility of the lungs of those who indulge in alcohol explains the high death-rate from consumption that is found to occur in places where it is freely taken. Observations made recently in France by Dr. Bauderon show that in certain districts where there is only a moderate indulgence in alcohol (12·5 litres per annum per person), the death-rate from tuberculosis is only 3·3

per 1000 inhabitants. On the other hand, in a district where the amount taken rises to 35·4 litres per person per annum, the death-rate for the same disease is 10·8 per 1000, *i.e.* three times as great as in some other parts of France.

In the sanatoria for consumptives at Loslau there are, according to statistics compiled in 1899 by Hoppe—

30 per cent of avowed alcoholics.
27 ,, of moderate drinkers (only drinking large amounts of beer).
27 per cent persons drinking very little.
6 ,, total abstainers.

These and other facts have made a profound impression on Europe, so much so, that at the International Congress on Tuberculosis, which met in Paris in 1905, the following resolution was passed :—

"That in view of the close connection between alcoholism and tuberculosis, this Congress strongly emphasises the importance of combining the fight against tuberculosis with the struggle against alcoholism."

Not only does the man who indulges in alcohol lay himself open to chances of tubercular infection, but his children are born with a diminished power of resisting this disease. The children of drinkers are frequently attacked by hip-joint disease, spinal disease, joint swellings, glandular swellings, "consumption of the bowels" and of the lungs, even although the parents are not tuberculous.

Syphilis.—Although most clinical facts bearing on the influence of alcohol have been obtained from the study of tuberculosis, it is, nevertheless, important to indicate that other diseases exist upon which alcohol has an influence as regards their onset and their course.

Nothing is more notorious in medical practice than that the man who takes alcohol frequently, is extremely likely to contract syphilis. Of course this is due, in the main, to the fact that moral control and continence is very soon annulled by relatively small doses of alcohol, and thus the individual, by his immorality of life, becomes infected. At the same time the resistance of the body to the microbes or virus of syphilis is distinctly lowered by alcohol, the aggravating influence of which, in the later stages of syphilis (even years after the primary infection), is well recognised.

It must be understood that the germs of disease are liable to attack any one, and that everything depends on the resisting power of the organism. Those who by heredity, by temperance, and by hygienic living, possess tissues whose resisting power is good, have every chance of repelling the invasion of germs; and even those who may have inherited tissues liable to become a soil upon which attacking germs are really able to thrive, can often keep the enemy at bay for an average lifetime, by obeying rigidly the laws of health as regards food and fresh air, and by abstaining from all alcoholic drinks.

Effect of Alcohol in preventing the Production of Immunity against Disease

Recent researches[1] by Dr. Delearde and others have brought to light the startling fact that immunity against disease cannot be obtained so easily by those habituated to the taking of alcohol.

Delearde's attention was attracted to the subject by noticing that of two patients, a man and a child, bitten on the same day by the same mad dog, and both given complete and careful antirabic treatment, the man of thirty, although only bitten on the hand, died, whereas the child of thirteen recovered, although bitten on the head and face, which are the most dangerous positions in which a patient can be bitten. In comparing the two cases, the only factor that could be found as unfavourable to the man was his tendency to be intemperate. Thereupon Delearde began a prolonged research as to the effect of alcohol on rabies in animals. Using rabbits, he proceeded to vaccinate them against hydrophobia, and was completely successful. Then, using other sets of rabbits, he proceeded to test the effect of alcohol administered to the rabbits in doses varying from $1\frac{1}{2}$ to $2\frac{3}{4}$ teaspoonfuls daily, in helping or hindering the acquisition of immunity during the whole period of vaccination against rabies. The result was both unexpected and startling, for no immunity was produced, the animals remaining just

[1] *Annales de l'Institute Pasteur*, Paris, 1897, vol. xi. p. 837.

as suseeptible to the disease as if no attempt had been made to vaecinate them.

When, however, aleohol was given before the vaeeination period but discontinued during the days of injeetion, Delearde found that a certain degree of proteetion against rabies was eonferred by the anti-rabie treatment, but that this proteetion was not so great as when no aleohol had been given throughout.

Investigations as to the Effect of Alcohol on the "Resisting Power" of Animals

Many most important observations have been made upon animals with a view to determining whether or no aleohol lessens their power of resisting disease, and it has been eonstantly found that this is so, and that the same rule holds as in man.

For instanee, during the eourse of investigations made (1895-8) by Professor Hodge regarding the influence of aleohol on dogs, there oecurred an out-break of distemper, which brought to light in a striking way the effeet of alcohol in lowering the power of resisting disease.

Distemper beeame epidemic throughout the city, and found its way into the kennel where Professor Hodge kept his dogs. In the kennel at that time the dogs taking alcohol were Bum, Tipsy, Frisky, Winnie, Berry II. There were four other dogs who were taking no alcohol. These had the complaint "mildly." On the other hand, the aleoholic dogs were the first

to take the disease, and they had it much more severely. Frisky was out of danger in a week, but Winnie died, and Tipsy and Bum were completely prostrated. Professor Hodge reports :—

"For over two weeks I hardly expected either of the dogs to live from day to day. Under ordinary care I have little doubt that both would have died. I resorted, however, to every possible device for feeding and proper medication. Alcohol was omitted from their diet, and though frequently offered to them they invariably refused food containing it. . . .

"In a word, the line was quite sharply drawn in the kennel between the normal and alcoholic dogs. All the alcoholic dogs, with the exception of Berry II. (and she had had the least alcohol of all), had the disease with considerable or very great severity.

"All the normal dogs had it in the mildest form possible. This would seem to indicate, for distemper at least, if not increased susceptibility to infection, a much diminished power of resistance on the part of the alcoholic dogs. The bearing of this result on various human diseases is too patent to require reference."[1]

It has been found by many other observers that animals to whom alcohol has been given succumb to infection from the germs of cholera, rabies, tetanus, and anthrax sooner than those that have had no alcohol.[2]

For instance, one experimenter[3] gave cholera to rabbits, some of which were free from, and others

[1] *Physiological Aspects of the Liquor Problem*, vol. i. p. 368.
[2] Doyen (*Arch. de Physiol.*, 1885).
[3] Thomas (*Arch. f. Exp. Path.*, 1893, Bd. xxxii.).

under the influence of, alcohol. He noticed that the alcoholised rabbits died from the effect of the cholera, whereas those who had not been given alcohol resisted the cholera microbe more effectively, some of them recovering, whilst those who succumbed did so less rapidly than the rabbits which had been given alcohol.

Similar experiments have been made by infecting animals with tubercle; and these experiments show that the disease runs a more rapid course in animals that have been given alcohol than in those that have taken none. This observation agrees with the now well-known fact that drinkers of alcohol show a predisposition to contract tuberculosis, often of a severe and rapidly fatal type.

In the case of diphtheria, very numerous experiments have shown that alcohol, given to the animal before or after infection by diphtheria, diminishes the normal resistance of the organism of the animal to infection in a very definite way.[1]

By this we mean that an animal that has had no alcohol is much less ill and makes a much better fight for recovery than the one that has had alcohol.

It is needless to quote further evidence, seeing that in all these diseases and in many others also it is now well established that both protection and recovery are alike grossly interfered with by alcohol.

[1] Tany Laitinier (*Zeitsch. f. Hyg. and Infect. Krank.*, 1900, Bd. xxxix. Heft 2). Also see researches of Valagussa and Ranalletti, quoted by Marcel Labbe.

Diseases caused by Alcohol

In addition to the foregoing definite infections, we are also constantly face to face with many permanent conditions of disease which are due to the progressive alterations that take place in the various tissues of the body as a result of a change in their metabolism caused by alcohol. No one disputes that a large number of the disorders which medical men are called upon to treat are traceable either directly or indirectly to the habit of taking this drug; and since we conceive it to be the duty of the medical profession to warn and advise the public, we introduce the following list as a clue to a state of affairs already known and recognised medically:—

Table I. includes those diseases whose existence entirely depends on the presence of alcohol in the body.

Table II. includes a large number of diseases which are constantly induced by alcohol, but which are also caused by other poisons alone or in combination with alcohol to a greater or less degree. For instance, obesity (fatness) is frequently induced by alcohol, but it is also brought about by other factors; for, as every one knows, hereditary tendencies and certain sorts of diet cause obesity, quite apart from the taking of alcohol by persons themselves.

In many of these disorders alcohol plays the part of the final determining cause of onset; that is to say, indulgence in its use definitely leads to the out-

break of, for instance, the attack of gout, eczema, or congestion of the liver from which the patient is suffering.

TABLE I. DISEASES DUE TO ALCOHOL ALONE

Acute Alcoholic Poisoning	(p. 84).
Acute Mania (*mania e potu*)	(p. 150).
Delirium Tremens	(p. 152).
Chronic Alcoholic Insanity	(p. 153).
Alcoholic Epilepsy	(p. 159).
Alcoholic Neuritis (Inflammation of the Nerve Sheaths)	(p. 162).
Alcoholic Paralysis	(p. 163).

TABLE II. DISEASES OF WHICH ALCOHOL IS FREQUENTLY A DETERMINING OR FREQUENTLY A CONTRIBUTING CAUSE

Throat . .	Pharyngitis (Catarrhal or Granular Sore Throat) . .	(p. 194).
Stomach . .	Gastric Catarrh and Chronic Dyspepsia	(p. 201).
	Dilatation of Stomach ..	(p. 205).
Liver . . .	Congestion of Liver . .	(p. 236).
	Hypertrophic Cirrhosis .	(p. 238).
	Cirrhosis of Liver . .	(p. 240).
	Fatty Liver . . .	(p. 238).
Kidney . .	Chronic Bright's Disease .	(p. 244).
Faulty Metabolism	Gout . . .	(p. 285).
Altered Tissue Change	Glycosuria . . .	(p. 285).
	Obesity	(p. 281).
Skin . . .	Congestion and Overgrowth of the Skin and its Glands. Inflammations of the Skin .	(p. 180).

Functional Disorders of the Ovaries and Breasts leading to—

	(1) Sterility . . .	(p. 284).
	(2) Inability on the part of mothers to suckle their infants at the breast . . .	(p. 327).
Heart . . .	Dilatation of Heart . .	(p. 261).
	Fatty Heart . . .	(p. 264).
Blood-Vessels .	Arterio - sclerosis (degeneration and fibroid change in the vessels)	(p. 270).
Lungs . . .	Increased susceptibility to inflammatory and infectious diseases, *i.e.* Inflammation of the Lungs, Consumption, Bronchial Catarrh, etc.	(p. 288).
Eyes . . .	Increased susceptibility to inflammatory diseases of the eye.	
Nervous System .	Inflammation and degeneration of nerve structures, including the optic nerve . .	(p. 162).
	Epilepsy . .	(pp. 159, 322).
	Melancholia . . .	(p. 156).
	Dementia . . .	(p. 153).
	Imbecility . . .	(p. 321).
	Hysteria . . .	(p. 158).
	Idiocy	(p. 321).
	Sunstroke . . .	(p. 160).
Infectious Diseases generally	*e.g.* Erysipelas, Blood-Poisoning of various types, Tubercle, Syphilis, Diphtheria, Cholera, etc.	(p. 291 *et seq.*).

EFFECT OF ALCOHOL UPON THE TISSUES OF CHILDREN

"The stern forbidding of the use of both alcohol and tobacco under the age of puberty would shield the nervous centres from two of their most deadly enemies."—Dr. GUTHRIE RANKIN, *Contemporary Review*, February 1906.

"Children should never know the taste of any alcoholic drink, and stimulants ought to be absolutely forbidden during school life. In adolescence they impair self-control and are a source of danger. At all ages when taken to relieve feelings of weakness or faintness, serious danger of falling under their influence is close at hand."—Sir WILLIAM BROADBENT, Bart., M.D., F.R.S., K.C.V.O., Physician-in-Ordinary to H.M. the King.

CHAPTER XIV

EFFECT OF ALCOHOL UPON THE TISSUES OF CHILDREN

Metabolism in Children.—The chemical tissue changes in adults, to which reference has already been made, is a relatively slow matter when compared with the rapid metabolism occurring in the case of children, which we must now describe.

Considered scientifically, the phenomenon of growth in a child is very remarkable, and is worthy of much more consideration than is usually accorded to it, for the body in childhood is practically a mass of cells whose protoplasm is undergoing or striving to undergo rapid and constant expansion and multiplication—the success obtained depending upon a proper supply of oxygen, food materials, rest, exercise, and sunshine. Now the body of an adult has no such heavy demands pressing upon it as regards growth; it merely has to provide for its repair and renewal of energy. In childhood matters are far otherwise, for every child has to face the strain and effort of building its body out of itself, and only when it is fully supplied with the requisite materials and the requisite time for rest (far more of these being needed in proportion to its

size than is required by an adult) is this "building" accomplished to perfection. Effective growth is entirely dependent upon vigorous protoplasmic activity, and anything which tends to lessen this protoplasmic activity brings, of course, the sum total of the development accomplished below the level of what was otherwise possible.

Effect of Alcohol upon the Growth of Children

As has already been shown (Chap. III.), alcohol, even in dilute solutions, has a depressing effect upon the vitality of protoplasm, and as all protoplasm is essentially of the same nature, it is more than likely that the growing tissues of children should be just as sensitive to the action of this drug as the plants and animals described in Chapter III. Evidence is steadily accumulating which suggests that the stunted frames and weak development of many poor children is at anyrate partly due both directly and indirectly to the action of alcohol. It acts adversely by lowering cell vigour, thus hindering the child's normal rate of growth, and also by directly irritating the stomach and liver, whereby the child's power of absorbing nourishment becomes impaired.

Professor Kassowitz, from his large experience of children's diseases in Berlin, directly attributes many of the cases of loss of appetite and digestive failure to the small amounts of light wines given to children by their parents at meal times. Many of these wines are astringent and constipating, and by no means

such simple drinks as they seem. In this connection we would suggest that some of the white pasty faces so frequently seen abroad in the children of all classes may be connected with their habit of taking wine. Though many parents of the present day, and especially during the last ten years, realise how harmful alcohol is to the young, we believe that in every country in Europe there are still many children whose bodies are more or less damaged and whose growth is impaired by the taking of alcoholic drinks. It must be remembered that organs thus injured in early life probably never reach their perfect development, and that in adult life, in consequence of such injury, the individual exhibits neither the full physique nor the normal longevity of his race.

One organ appears in childhood to be peculiarly susceptible to the action of small doses of alcohol, viz. the liver.

Of late years medical attention has been called to the state of the liver in some of the children who have been given small amounts of alcohol by their parents, or with their medicines (in the form, for example, of "steel wine"), and most doctors are now very much on the alert with regard to this sensitiveness of the liver to small or repeated doses of alcohol in childhood. With regard to liver disease in children, Sir T. Barlow, has more than once spoken strongly.[1]

[1] *The Use of Alcohol in Children's Diseases* (Address given at a Conference of Medical Men), Church of England Temperance Society Publication Depôt, 4 The Sanctuary, Westminster.

Before the Inter-Departmental Committee on Physical Deterioration (1903), he stated that it was—

". . . immensely difficult to give statistics, but easy to give illustrations. In a boy aged about ten years, who was under my observation for several weeks, there was well-marked evidence of gin-drinker's liver with abdominal dropsy. He had for a long time carried to his father, who was a cabman, his daily meal, of which some spirit was one of the constituents. The cabman had given the boy little sips of spirit, and he had got to like it.

"Again, a boy, aged between four and five years, was brought to me with abdominal dropsy and enlargement of the liver. He had been given a certain daily quantity of beer for several months. The beer was dropped, and suitable remedies were given. The dropsy rapidly subsided, and subsequently the liver slowly lessened in size, and the boy recovered.

"The occasional administrations of gin to children for flatulence is very common amongst certain classes of the London poor. The production of fibroid changes, or, in other words, the hardening and toughening of certain of the viscera of a child during the period of development, may be very far-reaching in its ultimate effects."

In association with this question of the adverse influence of alcohol given as an article of diet to children, we may quote the striking experience of Professor Demme, of Zurich, to the effect that in an epidemic of diphtheria, which occurred in the Jenner Children's Hospital, the children who had previously been accustomed to the daily and ordinary dietetic use of alcohol showed themselves much less

able to resist taking diphtheria, and succumbed to it in a greater proportion than did those children who had been brought up without alcohol.

Effect of Alcohol upon the School-Work of Children.—During the years of childhood no part of the body alters more rapidly or has greater capacity for growth than the brain. At birth its cells and fibres are of comparatively simple structure—and totally unlike the complex cells which are possessed by the adult. It is obvious that a brain built of badly grown cells, whose protoplasm is poor in type, can never attain to that mental power which is the essential of successful living.

This failure in brain development, which is the fate of many a child, is to be explained on the ground of lack of nourishment, sleep, and air, coupled with the practice of drug taking (tobacco or alcohol), and other pernicious habits.

The declarations of nerve physiology, which tell us that small doses of alcohol cause a slight numbing of the higher powers of the brain, of course apply equally to children as to adults, and in a research [1] made in American schools as to the cause of mental inability, weariness, and failure to respond to teaching, it was found that these symptoms were not infrequently due to the alcohol supplied to the children in their homes and in public-houses.

Other investigations, such as these of Heude in

[1] "A Study of the Effect of Alcohol on School Children," by T. Alex. M'Nicholl, M.D., *The Medical Temperance Review*, Aug. 1905.

Budapest, have shown indisputably that even in the case of children, who have already long been accustomed to the regular use of alcohol, single doses of from four to seven ounces, *i.e.* eight to fourteen tablespoonfuls, of wine cause the mental powers to lessen in every direction, so that the ability to learn by heart, to calculate, and even to write, are diminished to a striking extent.

Professor Demme refers to the following experiment performed by two capable and trustworthy men. They allowed their sons, between ten and fifteen years of age, to use wine for several months: after this, its use was discontinued for a similar period. In this way they continued to alternate for a year and a half. The wine used was a light table wine, and the older boy used $3\frac{1}{2}$ ounces at the noon and evening meals, and the younger rather more than 2 ounces, in both cases diluted with water.

Observations showed very plainly that during the period they were taking the wine the boys were "slacker," sleepier, and less interested in intellectual work. Their sleep was more restless and broken, and therefore less satisfactory than during the period of abstinence. The difference was so great that both the boys asked their parents to be allowed to omit the use of the wine.

Alcohol and Breast-fed Children.—It is noteworthy that breast-fed infants who are nursed by alcohol-taking mothers often have convulsions, and are very

restless and irritable—all of which nervous symptoms subside when the mother is induced to drink freely of milk and to abstain from alcohol.

This point is strongly enforced by Professor Kassowitz, of Berlin, who also states that when treating children who are delirious and seriously ill with pneumonia, influenza, and other diseases, he frequently finds that the delirium ceases when the alcohol which they may have been given medicinally is stopped; and he pleads strongly for the disuse of alcohol in the illnesses of childhood, because of its narcotic and irritant effects.

The further influence of alcohol on the nervous system of children becomes a medical question.

For instance, the *Lancet* (August 1899) reports three cases of alcoholic paralysis (one in a child four and a half years of age, who had received from one-half to a tumblerful of beer daily since the age of six months), and points out that there is no doubt as to the cumulative and deleterious effects of alcoholic drinks when taken by children.

Alcohol a Cause of Immorality.—Finally, all parents and teachers ought constantly to bear in mind that one of the most frequent causes of evil habits and of sexual immorality among young people is the taking of alcohol. This is, of course, a direct consequence of the action of even small quantities in damaging self-control, in perverting ideas and thoughts, and in exciting the emotions. A strong protest has been raised by Dr. Clement Dukes—than whom we have

no greater authority on the subject of schoolboys—with regard to the pernicious practice of allowing them to take beer in conjunction with other stimulating foods at supper-time.

> "Beer is a drug which deadens the will-power and excites the animal instincts of the young; its relation therefore to immorality is most momentous. . . .
>
> "In plain English, a master who allows his pupils to drink beer at bed-time, and a parent who sanctions it, implicitly says to them:—
>
> "I give you this beer at bed-time, well knowing that it will blunt your intellect, deaden your conscience, and diminish your will-power; and that at the same time it will excite your animal instincts."[1]

The same warning applies to young and still growing men and women when of college age, and for the sake of national morality as well as physique it is clear that in no form whatever should alcohol be used by the young either in childhood or adolescence.

[1] *The Use of Alcohol in Youth and its Results in our Public Schools*, by Dr. Clement Dukes, Physician to Rugby School (C.E.T.S. Pub. Depôt, 4 The Sanctuary, Westminster).

THE
INFLUENCE OF PARENTAL ALCOHOLISM UPON THE RACE

"Hereditary alcoholism is an undeniable fact."

"Alcoholism strikes a man not only in his own person, but also in his descendants."—Dr. LUNIER, Paris.

"In regard to the effects of alcohol upon the descendants, anything which devitalises the parent unfavourably affects the offspring, and clinical experience supports this in the lowered height and impaired general physique of the issue of intemperate parents. It also records the fact that no less than 42 per cent of all periodic inebriates relate a history of either drink, insanity, or epilepsy in their ancestors."—*Evidence given by* Dr. ROBERT JONES, F.R.C.S., *Med. Supt. Claybury Asylum, before Inter-Departmental Committee on Physical Deterioration*, 1903.

"Drunkenness is most distinctly hereditary. It seems to me to be a very strong hereditary tendency to a special craving."—Professor CLIFFORD ALLBUTT, M.D., F.R.C.P.

CHAPTER XV

THE INFLUENCE OF PARENTAL ALCOHOLISM UPON THE RACE

For many years it has been recognised by every dog-fancier and breeder of horses that the effects of heredity are indisputable; but only comparatively recently has attention been drawn to the large share played by inherited qualities in the formation of the bodily and mental characteristics of human beings. We have, indeed, been extraordinarily slow to grasp the thought that children represent the life and vitality of their parents and of their parents' parents before them, although we have long known full well that amongst the lower animals this scientific truth prevails, and that there is ample evidence of its being applicable to mankind. Although in the case of human beings thorough investigation of the subject is complicated by various factors, nevertheless, under the name of "Eugenics" (the science of good-begetting), a term introduced by that great student of heredity, Dr. Francis Galton, F.R.S., modern science has recently opened up a depart-

ment for the unravelling of these questions which affect human life and personality to so momentous a degree.

The evidence thus collected goes to show that the antecedent vitality of parents and grandparents markedly influences the lifelong health of a child and its powers of resisting disease; in other words, the evidence indicates (speaking broadly) that for a child to be really "well-born" at least two generations of healthy men and women must have played their part honestly and well. The Mosaic law insists that the "sins of the fathers" affect their descendants "unto the third and fourth generations," and the observations of modern medical and sociological science certainly tend to confirm this important but much ignored statement.

It is, of course, impossible for a mere onlooker to connect a special state of health in a girl or boy with what is observable by the outward eye in the physique of the parents, but the skilled physician finds it comparatively easy to understand the causes which account for the condition of body and mind in the children under his care, when the family history is known to him for two or three generations.

Our mental and moral characteristics also, as Darwin remarks,

". . . are the direct outcome of preceding generations, and we, the living generations, are like the living fringe of the coral reef, resting on an extinct basis formed by

our forefathers, and shall, in our turn, form a basis for our descendants."

The scriptural proverb that "grapes are not gathered from thorns nor figs from thistles" is particularly applicable to this situation. That so large a number of more or less mentally and physically incapable human beings should be born year by year is surely a world-wide disgrace, seeing that life is far from being an unmitigated good unless accompanied by an average amount of mental and bodily vigour; and yet thousands of children have their constitutions partially or wholly undermined before birth, while few people even protest or attempt to save them by aiming at a higher standard of thought than that which commonly prevails on this all-important subject.

Healthy Embryonic and Pre-Natal Life

In order to develop to perfection anything great or complicated in nature, favourable conditions are required, and if we apply this rule to the human body or brain, we shall begin to understand the supreme importance of safeguarding the unborn child from the very earliest moment, remembering that, after all, birth is but an incident in any human life-history, a history which really begins with conception.

At its origin, every life, whether animal or vegetable, passes through a germinal phase of existence, during which period it is by no means passive, but is dependent on being surrounded by healthy and

right conditions, if its subsequent development is to be a success. The original protoplasmic cells, which unite to form the beginnings of the future child, consist of very highly endowed and specialised protoplasm, possessed of the function of "development," thereby surpassing the powers of any other cell in the body. Now germ plasm may be initially healthy, or it may from the very first be feeble and devitalised; it may be surrounded before it starts on the journey of life with pure blood (having itself, with all its marvellous possibilities, been nourished by the same good blood), or it may be in a state of poor nutrition, because the blood of the parent (father or mother) is depreciated by protoplasmic poisons, by such drugs as alcohol or lead, or by diseases such as diphtheria, syphilis, etc.

Paternal Influence on Offspring

Although, as we have stated, some of the hereditary forces that influence a child come from more remote sources than the actual parents, nevertheless, it is, of course, also true that these latter hold in their hands much power for good or evil as regards the vitality of their offspring. It is customary to consider that the greater share of the responsibility belongs to the mother, although this is questioned by some authorities. In any case, the share of the father is undoubtedly large. For instance, Professor Adami describes a series of thirty-two cases in which the fathers suffered from lead-poisoning, whilst the

mothers were free from such condition. The offspring were affected adversely as to mortality, and showed signs of mental and other disturbances in a way that was very striking. Again, a case which is typical of hundreds of others is reported by Dr. Norman Kerr, in which first was born a son and then a daughter, who both mentally and physically were excellent specimens of vigorous humanity. After the birth of the daughter the father fell into habits of dissipation and rapidly became an habitual drunkard. He had four more children, of whom one was defective in mind, while the remainder were complete idiots.

Dr. Mott has lately published the following instance [1] :—

EXAMPLE OF DRUNKEN FATHER AND INSANE OFFSPRING

FATHER.	MOTHER.
Born 1830. No family history of insanity, fits, or nervous disease. Chronic drunkard from boyhood. In asylum, 12.6.76 to 11.7.76 ; and 19.1.92 to 8.2.92.	No history of insanity in family.

Daughter.	Daughter.	Son.	Daughter.	Son.	Son.	Daughter.	Daughter.
Born 1859. Admitted to asylum 24.10.74. Discharged and re-admitted on subsequent occasions. Still in asylum.	Born 1860. Admitted to asylum 6.10.74. Discharged and re-admitted on subsequent occasions. Still in asylum.	Born 1862. Admitted to asylum 29.6.77. Discharged and re-admitted and discharged on two subsequent occasions.	Born 1869. Admitted to asylum 2.1.92. Discharged and re-admitted. Still in asylum.	Born 1872. Admitted to asylum 24.11.88. Died of tuberculosis 4.9.02.	Not been in asylums.		

[1] *Brit. Med. Journal*, Oct. 28, 1905, "Heredity and Disease," by F. W. Mott, M.D., F.R.S., Pathologist to the London County Asylums.

Facts like these can only be explained by admitting that the condition of the health of the father has a marked influence on that of his offspring.

Possibly in this case there may have been a strain of initial mental defect in the father, which, when transmitted, was increased by the poisonous action of alcohol.

Only an insignificant number of drinkers' children are physically and mentally normal: 17·5 per cent according to Legrain, 6·4 per cent according to Demme, and 11·7 per cent according to Demoor, etc.

Arrivé found tuberculosis in 10 per cent of drinkers' children, but only in 1·8 per cent among the children of healthy parents.[1]

Maternal Influence

It is undisputed that the ultimate character and physique of a child is very greatly affected by the mental and physical condition of the mother. The Mosaic law insists strongly upon the importance of the observance of wise and careful regulations in regard to maternity; and the temperate habits of the Jews, together with and their obedience to certain rules laid down as necessary for married men and women, have resulted in the production of a

[1] *Alcoholism and Morphinism in Relation to Marriage*, by A. and F. Leppmann, Berlin.

magnificent race, possessed of greater average vitality and greater mental and moral force than is enjoyed by some of the nations of to-day who pride themselves upon being advanced in their civilisation, but who, nevertheless, are far behind the Jews as regards the health and consequent happiness of their children.

That maternal influence plays a large part in this matter has been recently enforced by scientific investigation, which establishes the fact that when the system of the mother is poisoned with a metal like lead frequent miscarriages occur, while of the few children who are born, a high proportion are feeble and devitalised. Alcohol, lead, and other protoplasmic poisons are all to be dreaded because of their power of undermining the vitality of the unborn child. Alcohol has been shown to pass in considerable quantities as such into the fœtus. Can we wonder if dire results follow? As a matter of fact, numbers of these children are born more or less malformed or debilitated, or they are still-born or non-viable.

On the other hand, observation shows that the general vigour and level of health of children born to abstaining and in other respects healthy mothers is markedly higher than the level of the health of children in parallel families the parents in which indulge in alcohol. It is true that at birth many children of alcohol-taking parents appear fat and well nourished, but the stamina of such children and their

power of resisting disease frequently proves to be feeble, whereas the children of abstaining mothers are in this respect better off.

Dr. Sullivan, "in a personal investigation carried out some years ago, ascertained that of 600 children born of 120 drunken mothers, 335 died in infancy or were still-born, and that several of the survivors were mentally defective, and as many as 4·1 per cent were epileptic."[1] This same authority reports a case like that of Dr. Kerr, in which the older children of a family were ordinary normal human beings, whilst the younger ones were neurotic, impulsive, and distinctly degenerate. The mother had become an inebriate before these younger ones were born. These are no isolated cases, as all who study the matter know full well.

To the medical expert it is evident that the question of maternal inebriety is one of national urgency. A community that cares for the general efficiency of its members will obviously safeguard the health of its women, inasmuch as these, from the very fact of their maternal functions, may either themselves become the resuscitating and repairing element in the race, or else may provide many of these very elements of deterioration which are so greatly to be dreaded. With this in view, the growth of alcoholism amongst women calls for legislative action from those who are sincerely interested in the future of the nation.

[1] *Alcoholism*, chap. on "Alcoholism and Degeneration."

"A strong sidelight upon the prevalence of drinking among women was thrown at the annual meeting of 1906, held in Liverpool, by the Society for the Prevention of Cruelty to Children. It was stated that during the twelve months the five inspectors employed by the local branch had dealt with no fewer than 10,288 cases, 10,007 being cases of 'general neglect'; and it was added that in the experience of the committee, 'the primary cause of the misery, cruelty, and neglect revealed is drunkenness, a crime by no means confined to the male parent, but largely shared by the mother.'"

Influence of Parental Alcoholism on the Nervous Systems of Children

The brunt of the evil heritage caused by alcoholism falls upon the nervous system of the next generation. Owing, first, to the deterioration of the germ cells, and, secondly, to the impoverishment of the system of the mother during the important months of pregnancy, children of such parentage frequently possess an enfeebled nervous organisation at birth. It may be impossible to recognise this immediately, although even during infancy impaired nerve vitality frequently shows itself in convulsions, meningitis, and other debilities.

With regard to mental development, many children of alcoholic parentage show signs of stupidity, mental deficiency, moral instability, and lack of normal control, whilst others exhibit idiocy, epilepsy, and hysteria, together with various unbalanced cravings.

The characteristic mental trait of the child of the inebriate mother is a warped or stunted intelligence accompanied by impulsive, uncontrolled actions. Parental intoxication tends to produce "impulsive degenerates" and moral imbeciles.

Mönkemöller found in the reformatory school of the town of Berlin hereditary taint due to parental alcoholism in 67·2 per cent of all the pupils.

Moreover, it would appear that it is not only in the case of parents who are habitual drinkers that the offspring are affected thus adversely. In a recent thesis on the subject,[1] the author, a doctor, shows the close connection between the alcoholic condition of the parents and the consequent detriment to the offspring. In these asylums, out of 2554 admissions, 1053 (*i.e.* 41 per cent) were the offspring of drunken parents, *i.e.* 933 had drunken fathers, 80 had drunken mothers, and 40 had both parents drunken. Concerning about 450 of these children no information could be gathered, while the remaining 451 were said to have "sober" parents. The investigation did not include, however, the habits of grandparents with regard to alcohol, and by the law of averages it is probable that some of these other children had grandparents who took alcohol freely, influencing thereby the mental development of their grandchildren. During the present century there will be, in England at any rate, a considerable number of both parents and grandparents who are total abstainers from all

[1] Dr. Eugene Trousson, *L'intoxication alcoolique chez les enfants.*

alcoholic liquids, and it will be of interest to note whether they possess as offspring children who are idiots and epileptic, or whether their families can claim freedom from this disaster.

With the four great classes of mental deterioration in children we now propose to deal, indicating where the alcohol factor in the parents appears to have an influence.

(1) Idiocy and imbecility.
(2) Epilepsy.
(3) Feeble-mindedness.
(4) Mental deficiency as shown in school-work.

1. Idiocy and Imbecility a result of Parental Alcoholism

According to the authority of Drs. Shuttleworth and Fletcher-Beach, parental alcoholism is a factor in 16⅓ per cent of the cases under their care at the Royal Albert and Darenth Asylum for Idiots and Imbeciles. Analysis of 2380 of their histories shows that consanguinity, consumption, epilepsy, mental disease, etc., in the parents, form other factors, the history of intemperance being associated with one or more of these in the percentage above stated.

It may be noted in passing that this 16 per cent refers only to actual intemperance in one or both parents, which at the time when the investigation was made, some years ago, was the only point at

practical issue. In the light, however, of our present knowledge of the action of even small doses of alcohol upon the nervous system (see Chap. V.) it is not unwarrantable to suggest that probably the depressing action of even ordinary doses of alcohol upon the developing brain of the unborn child is more profound than is at present recognised, and that hence alcohol may be a more potent cause of idiocy than the foregoing figures represent.

2. Epilepsy often caused by Parental Alcoholism

There is very strong evidence to show that parental alcoholism is one of the most frequent causes of epilepsy in children.

Epilepsy and imbecility often go hand in hand, but if for the moment we deal with epilepsy alone, we find that alcoholic mothers possess a far larger number of children afflicted with epilepsy than do the ordinary mothers of the same social position.

In an investigation by Dr. W. C. Sullivan as to the health of 219 children who had alcoholic mothers, it was found that 4·1 per cent became epileptic, whereas in the general mass of the population the frequency of epilepsy averages below $\frac{1}{2}$ per cent. Other writers have found that from 12 to 15 per cent of the surviving offspring of alcoholics become epileptic.

Dr. Legrain[1] personally followed up the de-

[1] *Social Degradation and Alcohol*, by Dr. Legrain.

scendants of 215 drunkards, and found that in these descendants epilepsy, insanity, and other nervous disorders were extremely common. He also found that the families rapidly died out—a large number of the children dying young.

Alcoholism in Parents a cause of Insanity in their Children

It will be noted in the paragraph above that, in addition to suffering from idiocy and epilepsy, the children of alcoholics often become insane. This, after all, is only what may be expected when we once learn to recognise the extreme sensitiveness of the nervous system to drugs, and its peculiar susceptibility to the poisonous effects of alcohol.

3. Feeble-Mindedness

Public attention is at this moment being directed to the "problem of the feeble-minded," and those experts who have devoted most attention to the subject regard alcohol as certainly one of the causative factors in that deterioration of brain-tissue which lies at the real root of the mental inability and feeble-mindedness of so many human beings.

In addition to those whose feeble-mindedness is quite apparent, we have in our midst thousands of children more or less mentally deficient, many of whom are attending our day-schools, and are the despair of their teachers, by whom they are known

as "dullards." These supply the ranks of the criminal and vicious who fill our reformatories, workhouses, and gaols, and their numbers are reinforced by a large contingent of other children who, although fairly bright at their lessons, are nevertheless morally defective.

People recognise that it is the duty of the Legislature to deal with such facts as these, but we would point out that it is no less the duty of science to indicate the cause or causes of this state of things, in order that measures which are really preventive and remedial may take the place of those which, for want of fuller knowledge, are at present in vogue. It is not sufficient to spend money freely in striving to isolate these "degenerates," nor even to attempt to educate their permanently impaired (and consequently more or less hopeless) brains; some scheme is needed whereby their creation shall be checked, and such flagrant deterioration of nerve tissue be prevented from occurring. In as far as this deterioration is due to the taking of a drug or drugs, we contend that the State ought certainly to interfere and strive to improve the social habits of the community, when these habits threaten to undermine national efficiency and vitality.

4. Mental Deficiency as shown in the School-Work of Children

In a study of the mental deficiency of ordinary children undertaken in 1901 for the New York

Academy of Medicine by Dr. MacNicholl, the effect of alcohol as a factor in the causation of such deficiency was strikingly shown. Fifty-five thousand school children were examined. Of these 58 per cent were below the required standard of intelligence, 17 per cent being actual "dullards," 25 per cent "very deficient," and the other 16 per cent merely deficient.

The habits of the parents with regard to alcohol is reported in 20,147 cases :—

Children of drinking parents . .	6,624	
" " reported dullards		53 per cent.
Children of abstaining parents . ..	13,523	
" " reported dullards		10 per cent.

The family histories of 3711 children were traced through three generations. This was done in great detail with regard to the taking of alcohol. Of the children of abstaining parents and abstaining grandparents only 4 per cent were "dullards," whereas of the children of abstaining parents but drinking grandparents, 78 per cent were "dullards."

Dividing the 3711 children into two classes, viz. those free from hereditary alcoholic taint, and those with hereditary alcoholic taint, we note very striking contrasts :—

(1) Of those free from hereditary alcoholic taint—

96 per cent were proficient.

4 per cent were dullards.

18 per cent suffered from some neurosis or organic disease.

(2) Of those with hereditary alcoholic taint—
23 per cent were proficient.
77 per cent were dullards.
Of these dull children more than one-third were very deficient.
Of these same children with hereditary alcoholic taint, 76 per cent suffered from some neurosis or organic disease.[1]

"At a discussion on this subject at the Vienna Congress against alcoholism, a medical man stated that the teachers in wine-growing districts of Lower Austria know that a supply of very bad scholars in any one year denotes a good vintage six years previously." [2]

Alcohol and Infant Mortality

In connection with the outcry about our declining birth-rate, attention is being turned to the grievous waste of infant life which occurs during the first few months after birth. It is a curious fact that, although our knowledge of disease and its prevention has resulted in the lowering of the general death-rate, it has failed to lessen the appallingly high death-rate of infants, which has not decreased materially during the last twenty-five years. Several factors are at work in causing this mortality, overcrowding, insanitary dwellings, hand-feeding in

[1] "A Study of the Effect of Alcohol on School Children," *Medical Temperance Review*, Aug. 1905.

[2] *Alcoholism and Morphinism in Relation to Marriage.* Drs. A. and F. Leppmann.

place of breast-feeding, alcoholism and disease, all being to blame. The part played by alcohol is unfortunately a very considerable one, it being both directly and indirectly responsible for the death of many infants, because of its power of directly inducing :—

(1) Lowered vitality of offspring.

(2) Deficient lactation on the part of mothers.

With the first of these effects we have already dealt in the earlier portion of this chapter. As regards the second, inasmuch as it concerns a piece of research-work not yet confirmed or repeated, and still under criticism, we have preferred to quote from the original author, Professor Bunge, of Bâle, in full, leaving to him the full responsibility of the theory promulgated.[1]

2. **Deficient Lactation.**—A very large number of infants die annually, or have their health permanently injured, because they do not receive the mother's milk, which in a normal woman ought to flow in sufficient quantities to provide for the child's sustenance for six or nine months after birth.

So important and so serious to the race is this failure in the maternal economy that it has led to a prolonged investigation by Professor Bunge, who considers that a normal woman ought to be able to suckle her child for nine months.

"Setting out from purely scientific researches, carried out without the least idea of their tendencies, or the slightest

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[1] Die zunehmende Unfähigkeit der Frauen ihre Kinder zu stillen G. von Bunge.

preconceived idea, I have for the last thirty years occupied myself with chemical researches on the composition of milk. I have compared human milk with the milk of the other mammals, and these researches have made me perceive that the composition of milk is one of the greatest marvels of living nature. I have seen with what circumspection nature had adapted the composition of milk to the needs of each species of mammal; how it has known to mingle the component parts of the milk in a precise relation to the wants of the nursling, so that it may grow and become identical with that of its parents. Then needs are very different in the different mammals, especially in proportion to the fact that the rapidity of increase of the different species in itself is very variable. . . . *Human is more complex in composition than the milk of all the other mammals. We find therein a substance, namely lecithine, which serves for the construction of the brain*, because the weight of that of the child's is relatively the highest.

"These indications suffice to show that we could not replace the milk of one species of mammal by another without injury to the nursling; and notably that we could *not replace human milk by the milk of the cow.* All practical experience is unanimous on this point. Consequently all imaginable attempts have been tried artificially to make cow's milk to resemble human milk; water has been added, and sugar, etc., without ever attaining the end desired.

"Many physicians are of the opinion that if artificial feeding is carefully carried out children get on as well as they do with maternal lactation. That is quite unlikely. If we wished to verify the truth of that assertion, we should not content ourselves with comparing the development of the children at the first year of their lives. *We ought to pursue the comparisons during the whole course of their lives.*

No such researches exist. But even if we admit that, by a *careful direction* of artificial lactation, the children might be as prosperous as if they had been fed by the breast, we should nevertheless have to confess also that among the majority a *careful direction* will never be possible, simply because we can never replace the powerful instinct of maternal love by a feeding-bottle. It is only when the mother carries her infant on her breast that these cares can be sufficient. Such is the wish of nature; the infant ought to remain close to the mother. The mother is thus forced to take care of the infant as she does of herself, and even more, to sacrifice herself to it.

"Statistical data plead in favour of this principle. It has, for instance, been ascertained in Berlin that in the case of infants fed by cow's milk, the mortality in the first year of life is six times as high as it is among those fed by breast milk. It is possible that the situation may be better in other cities; but we may, however, affirm that, in all civilised peoples, in good or bad years, hundreds of thousands of infants are killed by feeding on cow's milk, and even more than killed, let us say tortured, by a slow death.

"The question may be put: *Why women do not effectively suckle their infants?* Some put forward the difficulty of so doing; others are prompted to it by bad husbands. But these only form a very small minority. The number is greater of those women whom professional occupation keep from lactation. But these also form a minority. The majority of the women who do not suckle their infants are composed of those who *cannot, physically speaking, do so.* The quantity of milk is not sufficient; artificial feeding must be superadded, and, at the end of some weeks or months, the source of the milk is completely dried up.

This inability to suckle is in constant increase. In the towns of Germany and Switzerland more than half of the women are already attacked by this inability.[1]

"I have made it my task to find out the causes of this inability by means of statistical procedures. I first of all found it to be hereditary. When a woman is unable to suckle, it is almost without any exception that her daughter cannot do so, and the power appears to be lost for all the next generation. If we inquire of a woman who has suckled her infant successfully for nine months or more, if her mother had equally been able to suckle, the reply is almost without exception in the affirmative. If we ask a woman who has not been able to suckle her infant for the full time, we find that already her mother has not been able to do so, in the majority of cases, but not in all. There are some cases, and these are not rare, where the mother having been able to suckle, the daughter has not been able to do so. Here we are close to the causes of the incapacity, and shall *find it in the father, and we at once encounter alcoholism.* In 78 per cent of these cases, in my statistics, the father is an immoderate drinker. On the other hand, in the families where the mothers and daughters can suckle their infants, drunkenness is rare; in other words, that the daughter of a drunkard is in a position to be able to properly suckle her infant is a rare case. The rule is, that *if the father is a drunkard, the daughter loses her power of suckling.*"

The extreme importance of this subject cannot be over-estimated, and it is much to be desired that a similar research should be established in other countries in order to determine whether in general

[1] By "inability" Prof. Bunge means inability to suckle for nine months.

a deficient activity of the mammary gland can be traced to parental inebriety.

Indirect Effect of Alcohol in causing Infant Mortality. —Briefly summarised, the indirect effect of alcohol in leading to infant mortality is as follows:—

(*a*) Money is wasted by the parents on alcohol, although required to buy good food and milk for the mother and the child. There is a popular belief that stout and porter taken by a nursing mother lead to an increased secretion of milk, and so it happens that many a woman takes these liquids in the honest faith that they are helping her to feed her child. The real truth is that although malt liquors stimulate for a time a secretion of extra milk, this secretion is of a watery nature, and is therefore of inferior nutritive value to the child. For instance, cows are frequently fed upon malt grains in order to increase the amount of milk they supply regardless of its quality.

(*b*) The inertness of body and mind induced by alcohol leads to maternal laziness and neglect, whereby dirt and semi-starvation prevail in the home and often lead to illness and death.

(*c*) The drowsiness and lethargy of the alcohol-taking mother is recognised as a frequent cause of the overlaying of infants. Thus Dr. Templeman states—

"There can be no doubt, too, that drunkenness on the part of parents is a very important factor in the production of our infant mortality. Apart from the effects of this on

the child *in utero*, there is another aspect to which I could allude, viz. deaths from overlaying. These cases occur, as a rule, in one and two-roomed homes, and in a large majority of cases in families in which the parents are of dissipated and dissolute habits, and living amidst squalor and filth. Of 461 cases which have come under my own observation as Surgeon of Police during the past twenty years, no fewer than 219, or 47 per cent, occurred between Saturday night and Sunday morning, a fact which speaks for itself."

In 1903-4 the mean annual number of deaths of children in London from overlaying was 612. The large majority of cases occurred on Saturday and Sunday nights.

The Question of Parental Alcoholism studied in Animals

Of great interest in this connection are the facts published by Professor Hodge with regard to the influence of alcohol upon the progeny of animals.

The investigations were made with the dogs already alluded to (p. 123), and so striking were his results that he considers them to be "the most definite of the entire research."

To the two dogs who were given alcohol with their food, 24 puppies were born, many of which were deformed or dead. In fact, out of 24 puppies in four consecutive litters only 4 proved viable; and finally, after giving birth to 3 perfectly formed but dead whelps, the mother, in spite of very prompt assistance and the best care, died also. On examining her body,

it was found that the womb was in a state of fatty degeneration.

Matters were very different on the side of the normal pair. Out of 45 puppies born in eight consecutive litters, 41 were "viable and exceptionally vigorous." Three puppies had hare lips.

After alluding to another similar series of experiments on other dogs, the author continues—

"In the matter of non-viability these puppies (of the dogs who took alcohol) seemed as inexplicable as many cases in man. They simply would not put forth the least effort to make a "live" of it. I spent hours milking into their mouths, but to no avail. Examination of the brains of a number of these pups failed to show any trace of medullation; whereas normal pups killed at birth were found to possess medullated fibres in the sensori-motor areas. This seems to be the only clue to their lack of vigour."[1]

Professor Hodge quotes in the following table the "strikingly similar results of Professor Demme, obtained from comparative observations upon alcoholic and non-alcoholic families"—

	10 Alcoholic Families.	10 Normal Families.
Number of children .	57	61
Deformed . . .	10	2
Idiotic . . .	6	0
Epileptic, choreic .	6	0 (2 backward)
Non-viable . .	25	3
Normal . . .	10 = 17 per cent.	54 = 88·5 per cent.

[1] *Physiological Aspects of the Liquor Problem*, vol. i. p. 374.

Researches as to the Effect of Alcohol upon Hens' Eggs

In 1894-1903 Dr. Féré made experiments upon the influence of alcohol on hens' eggs hatched in incubators. Alcohol was applied as a vapour or by means of injection, and in every case there were control specimens hatched in other incubators without being subjectd to such toxic agency. His results showed conclusively a large percentage of abnormalities in the chickens hatched under the influence of alcohol. This appeared in the form of deformities, monstrosities of body, and feebleness and lack of intelligence and of instinct (conditions comparable to the idiocies and imbecilities of mentally deficient children), while a large percentage of the chickens were found dead or still-born. Eggs hatched under normal conditions did not present anything approaching the above proportion of abnormality.

Again—

"When guinea-pigs are subjected to the continuous use of alcohol during pregnancy morbid changes are found in the brain of the offspring. There is also a marked stunting and deficiency of growth and weight. There is a much greater tendency to disease and death."[1]

Various other experiments are on record, but these examples must suffice to show the trend of the results.

[1] *The Hygiene of Mind*, Clouston.

The Influence of Heredity upon Inebriety

The question is sometimes debated as to how far the tendency to inebriety is inherited. Proof is wanting as regards the existence of a distinct inebriate diathesis which is handed on and cannot be resisted, and by means of which the drinker suffers early elimination from the race. On the other hand, careful scientific investigation shows that the children of inebriates inherit a faulty organisation and an impaired type of nervous system, which often leads to their also falling victims to the "craving" for alcohol, especially when surrounding social and industrial conditions encourage indulgence in its use.

In order to elucidate the influence of heredity as a direct or indirect cause of inebriety, a prolonged investigation, lasting thirteen years, was undertaken by a committee of doctors in America, the results of which have not yet received full publication. In a preliminary statement, Dr. Crothers, their chairman, reports that the histories of 1744 cases of inebriety have been obtained, which may be classified as follows:—

Distinct history of heredity . . .	1080
Disease, injury, shocks, strains, and infection .	390
Starvation and poisoning	180
Exposure, ignorance, mental contagion . .	85
Causes too complex for classification . .	9

He says—

"The heredity of inebriety is established from such studies

beyond all possible question and doubt. The central conclusion, which cannot be stated too strongly, is: that the injury from alcohol to the cell and nervous tissue is transmitted to the next generation with absolute certainty in some form or other. It may not always appear in the drink and drug symptoms, but the injury breaks out again in some neurotic trouble, defect, or predisposition.

"Part of the tragedy which surrounds this question of heredity is due to the fact that some children inherit from parents accustomed to moderate drinking a food craze and abnormal hunger which never seems to be satisfied. This early provokes dyspepsia and inebriety.

"Another class is born with a precocious sexual instinct, which seeks gratification apparently without limit or control."

Often there appears to be a passing over of inherited predispositions from one to a third or fourth generation, the descendants being liable to instability and lack of will-power, and to "invalidism" of all grades and types; persons, namely, whose lives are a perpetual struggle against some bodily or nervous difficulty.

Whether the actual taste for alcohol is ever inherited is at present a somewhat open question; but in face of the fact that so many other "cravings" haunt the life of the descendant of alcoholic parents, it seems not unlikely that he should possess a sense of "need" for the sedative effect of the drug.

Special Inheritance of Nervous Instability.—As pointed out by Dr. Clouston, there are, unfortunately, in the British Isles thousands of persons who have inherited from alcoholic parents an impaired type

of nervous system which makes its owner more susceptible to the action of alcohol than would be a normal person.

These persons possess but feeble brains and their will-power is below normal; for them, therefore, any alcoholic drink is liable to be a dire mistake, since it may arouse a "craving" which has so far lain dormant, but which, when once awakened, cannot be controlled by the feeble will-power at their command. Many of these persons drink because they simply have no will-power to abstain.

Conclusion.—That alcohol affects disastrously the minds and bodies of innocent unborn children must be the undoubted conclusion of those who weigh the evidence of this chapter; and the question arises as to whether any opening exists whereby the appalling force of hereditary influence can be mitigated.

It must always be borne in mind that the upward trend of evolution is in favour of the effacement of morbid and wrong tendencies; that all things being equal, the good surmounts the evil, and that it is health which strives to have the last word. Hence the existence of an alcoholic tendency in a family is not to be regarded as implicating all its members, but merely means that being forewarned they should be able to counteract any special dangers which may have been inherited, by assiduously cultivating habits of right living and by the careful avoidance of the use of alcohol in any form—this being a danger which they are forbidden to brave.

THE INFLUENCE OF THE DRINKING OF ALCOHOLIC BEVERAGES ON THE NATIONAL HEALTH

BY

ARTHUR NEWSHOLME, M.D., F.R.C.P, D.P.H.

" If I could destroy to-morrow the desire for strong drink in the people of England, what changes we should see. We should see our gaols and workhouses empty. We should see more lives saved in twelve months than are consumed in a century of bitter and savage war."—Mr. JOSEPH CHAMBERLAIN, 1874.

" A universal cry of despair rises from the whole universe at the sight of the disasters caused by alcoholism. . . . This invasion of alcoholism ought to be regarded by every one as a public danger, and the principle that the future of the world will be in the hands of the temperate ought to be inculcated into the masses as a truth that is incontestable." —Speech of Prof. BROUARDEL at Congress on Tuberculosis, 1901.

" The latest and most authentic statistics show that over ten per cent of all mortality is due to the abuse of alcohol, and fully twenty per cent of all disease is traceable to this cause; also, that over fifty per cent of insanity, idiocy, and pauperism springs from this source. All authorities agree that from seventy-five to ninety per cent of all criminality is caused by the abuse of alcohol. These and other well-authenticated facts indicate the necessity of a more exact medical study of alcohol and its effects and influence on society and the individual." — By T. D. CROTHERS, M.D., Hartford, Conn., Superintendent Walnut Lodge Hospital, 1905.

CHAPTER XVI[1]

THE INFLUENCE OF THE DRINKING OF ALCOHOLIC BEVERAGES ON THE NATIONAL HEALTH

Standard of Life influenced by National Expenditure on Alcohol

THE following figures will, it is hoped, enable some faint conception to be obtained of the national importance of the subject with which this book deals. Each year official returns are issued by the Board of Trade, which make it practicable to estimate for the United Kingdom the amount of alcoholic beverages which, on an average, each person annually drinks. During the year 1903, the amount of beer drunk per man, woman, and child was 29·7 gallons, which is more than the amount drunk in any other country except Belgium. In addition, each person drank close on a gallon of proof spirit and two-fifths of a gallon of wine during the same year. Now, of every 1000 persons in the general population, 576 are

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more than twenty years old. If we assume that all of this liquor is drunk by persons over twenty years of age, and that women drink as much as men, this means that each adult drinks annually 51·6 gallons of beer, 1·82 gallons of proof spirit, and 0·69 gallons of wine. Putting it another way, the average weekly consumption for each adult is about eight pints of beer, a third of a pint of proof spirit, and a tenth of a pint of wine. In actual fact, much larger quantities than these are taken by a much smaller number of persons.

Even this statement scarcely enables one to realise the significance of the figures quoted above. Let us consider what it means in money. This can be stated with some degree of exactitude, as official figures are published year by year. In 1904 the population of the United Kingdom was nearly forty-three millions, and this population spent 169 millions sterling on alcoholic drinks, an amount which was 5½ millions less than in the previous year. This means that on an average each person in the United Kingdom spent during 1904 £3 : 19s. on alcoholic drinks. But as the consumption of alcoholic drinks is almost entirely confined to persons over twenty years of age, it follows that every person over twenty spends on an average £6 : 17 : 2½ per annum on alcoholic drinks. The wage-earning classes form about four-fifths of the total population, and they probably spend about two-thirds of the total money devoted to the purchase of alcoholic drinks. On this assump-

tion each adult of the working classes spends 2s. 2½d. a week on alcoholic beverages. There are usually two such adults, and often three, in each working-class family. It will be perfectly safe to say that at least 5s. on an average is spent on alcoholic drinks in each of these families. As some spend less or nothing at all in this direction, others must and do waste a much larger weekly amount on such expenditure. We will assume, however, that the amount is only 5s. a week. Consider what this sum would do, if wisely spent. If placed as an insurance premium in the Post Office year by year, beginning at the age of twenty-five, it would mean for the husband that he would have the sum of £422 at the age of fifty-five, or his wife would obtain this sum if her husband died at an earlier age. This £422 invested in an annuity for the husband would furnish a yearly income of £32 : 10s., or 12s. 6d. a week; for the wife, if similarly invested, a slightly smaller income.

Such a provision would not exhaust the saving which would result from spending no money on alcoholic drinks. The improved health of parents would imply saving of money, and increase of efficiency in every direction. The general standard of life of the family would be raised. It is by this raising of the standard of life of the wage-earning classes, who form the majority of the population, that the prosperity of the nation can be most certainly promoted. The brewing trade pays in wages for every £100 value produced much less than the

majority of trades, only about one-third or even only one-seventh of many of them. The diversion of the same amount of money as is now spent in producing alcoholic drinks to increased food, rental, clothing, and other comforts, would react on nearly every trade in the community, and would greatly enhance our national prosperity. This statement allows nothing for the partial emptying of our prisons, workhouses, and lunatic asylums, which would follow the abolition of alcoholism, and the releasing for more useful purposes of the money and energy which this economy would secure.

During the last twenty years the wages of the working classes have risen. Between 1881-5 and 1900 the average wages in this country rose 20 per cent. During the same period the cost of food to each family declined 25 per cent, and of clothing 5 per cent, rent rising 12 per cent. Taking all these items together, the total of the chief expenses of a working-man's family fell over 14 per cent. This is an average statement, which, while it does not exclude the fact that among a section of the population, especially unskilled labourers, there is still a very low standard of life, shows that the majority of the wage-earning classes have greatly improved in their possibilities of social comfort and prosperity. It is clear, however, that as on the average the heads of the household of every wage-earning family spend at least five shillings a week each on alcoholic drinks, a large share of this increased prosperity is being wasted.

It is lamentable that up to the present time the consumption of alcoholic drinks varies closely as national prosperity varies, and not in accordance with our increasing knowledge of the evils of drinking, even of so-called moderate drinking.

Our national expenditure on alcoholic drinks means more than wasted money. It implies an enormous mass of wasted health and of lost lives. It would form an interesting subject for speculation whether the amount of alcoholic drinks now consumed in the United Kingdom would do more harm in the aggregate if an equal amount were consumed by every adult, or if, as now happens, a very large number took little or no alcohol, and others indulged in amounts which every one agrees are excessive. So-called moderate doses of alcohol can be proved experimentally to inflict serious injury, and the experience of insurance offices points in the same direction.

Statistical Understatement of Number of Deaths due to Alcohol.—The first class of statistics with which we have to deal is those published by the Registrar-General, which state the number of deaths annually caused by alcoholism and certain diseases, like cirrhosis of the liver, which are known to be almost strictly confined to topers. For obvious reasons, the number of deaths registered under these heads is greatly understated.

The doctor in attendance hands the death-certificate to the nearest relative of the deceased, and he is

Fig. 19. — Showing from the Registrar-General's return the death-rate according to the habits of individuals. The term "adult males" refers to the general male population.

careful not to hurt that relative's feelings. Often, also, alcohol produces lesions which may be caused by other agents, and the disease named on the death-certificate gives no clue as to which of these is operating. So far, therefore, as our national death-returns for the general population are concerned, statistics only tell a minute fraction of the total mischief done by alcohol. Thus, in England and Wales, during the year 1903, only 1475 deaths of males and 1075 of females were returned as caused by alcoholism and delirium tremens,

Fig. 19.—The unshaded column marked "Abstainers" is not derived from the Registrar-General's returns, but from the experience of the Independent Order of Rechabites for the years 1878-87, the figures being stated in terms of a "standard population" identical with that of the Registrar-General.

and 2196 deaths of males and 1720 deaths of females were ascribed to cirrhosis of the liver, a disease known to be nearly always due to alcoholic indulgence.

Comparative Mortality for Various Trades and Occupations.—We must turn to the Registrar-General's statistics for special occupations to obtain a clearer insight into the havoc wrought by alcohol. This authority gives "comparative mortality figures," showing the relative number dying in different occupations out of a given number living in those occupations at the same ages. Thus, if the comparative mortality figure for all men equals 1000, an equal number of gardeners would only have 568 deaths, teachers 571, grocers 664, doctors 957; while at the other end of the scale are brewers 1407, inn-keepers and inn-servants 1665, and filemakers 1791. The practical importance of these facts, and of similar facts which are well known, is shown by the practice adopted by insurance societies, as contained in the following extract from Allbutt's standard *System of Medicine* :—

> It is customary to add 50 per cent extra for such dangerous occupations as the drink trade, even if classed as A_1 by the medical examiner; but it is probably wiser to follow the rule of the more cautious offices, and absolutely to decline to accept proposals in such cases.

Why is it that a publican's chance of premature death is three times greater than that of a gardener, and that it is nearly as risky to be engaged in a

public-house as in the extremely dangerous industry of file-making? The reason must be sought in a further examination of the diseases to which those engaged in selling alcoholic drinks are subject. Comparing employees in inns (inn-servants) with all occupied males, we find that out of a given number in each group, among inn-servants 8 times as many die from alcoholism, $5\frac{1}{2}$ times as many from gout, $1\frac{3}{10}$ times as many from diseases of the nervous system, $1\frac{4}{5}$ times as many from suicide, $2\frac{1}{2}$ times as many from consumption, and so on.

Consumption and Cancer.—Consumption and cancer are two of the most dreaded diseases, and they are two of the most common causes of death. Out of every 1000 deaths in England 78 are caused by consumption, and at least 56 by cancer. Both these diseases are more frequent among those who indulge in alcoholic drinks than among abstainers.

Consumption is due to infection by a microbe, the tubercle bacillus, which is discharged with the expectoration or spit of persons suffering from the same disease. The infection is commonly inhaled by others in the form of dust, which consists in such cases largely of dried expectoration, resulting from careless spitting by consumptives on floors of rooms, etc. But why do those working in public-houses and those who frequent public-houses suffer much more from consumption than others? Doubtless much of the mischief is caused by direct infection at the bars of public-houses. It is well known that, as a rule,

frequent doses of infection are required before active consumption is produced. To frequent a public-house is one of the most certain ways of receiving these frequent and large doses of infection. But this is not all that indulgence in alcoholic drinks implies. If so, infection might be avoided by drinking at home. It has been shown, however, that alcohol lowers the resistance to infection; in other words, it opens the door to infection; it prepares the soil on which the seed of infection grows. This is well known to be true not only for consumption, but also for such diseases as pneumonia, typhoid fever, erysipelas, blood-poisoning, etc. A great French physician, Dr. Brouardel, has well stated the matter in the following words: "Alcoholism is in effect the most powerful factor in the propagation of tuberculosis. The most vigorous man who becomes alcoholic is without resistance before it."

As with consumption so with cancer, there is a great excess of disease in persons employed in those occupations in which alcoholic indulgence is common. According to the Registrar-General's figures, the same number as would furnish 44 deaths from cancer among all occupied males, 35 among clergymen, and 43 among doctors, would furnish 63 deaths from cancer among commercial travellers, 70 among London inn-keepers, and 70 among brewers. In an investigation which I made as to the persons insured in the United Kingdom Temperance and General Provident Institution, I found that the same number living at the

same ages which gave 100 deaths from cancer among the non-abstainers, only gave 71 deaths among the abstainers. This is not surprising when we remember that one of the factors producing cancer is the influence of chronic irritation, and alcohol causes irritation of the tissues with which it comes into contact.

Comparative Death-Rates of Abstainers and Non-Abstainers

We have seen that the statistics of persons engaged in different occupations give us a better insight into the ravages of alcoholism than do the statistics for the whole community. Happily there are now exact statistics available comparing, in a manner free from fallacy, the relative experience of abstainers and non-abstainers on a large scale.

Thus the incidence of sickness and mortality among abstainers from alcohol and non-abstainers is very clearly demonstrated by the statistics of the friendly societies.

From the Report of the Public Actuary of South Australia, Mr. H. Dillon Gouge, F.S.S., we extract the following facts :—

	Average Rates.	
	Mortality per cent.	Sickness Weeks.
Abstainers' Societies average . .	0·689	1·248
Non-Abstainers' Societies average .	1·381	2·317

So, too, the contrast between the percentage death-rate among the members actually sick, and the average weeks of sickness suffered by the two classes is striking :—

	Mortality per cent of Sick Members.	Average Weeks of Sickness per each Member Sick.
Abstainers' Societies average . .	3·557	6·45
Non-Abstainers' Societies average .	6·532	10·91

To this must be added the statement that many of the members of the "non-abstainers'" societies, *i.e.* Foresters and Oddfellows, are, in fact, abstainers. The contrast would have been even stronger had they been truly all non-abstainers.

The net result approaches two to one in favour of the abstainer, who thus lives longer and more healthfully than his non-abstaining friends. And, finally, when he is sick he makes a more speedy recovery.

The insurance office already named has, among others, collected its experience for a long series of years. During this time over 14,000 deaths occurred, and as these and the total lives insured throughout have been kept in separate groups of abstainers and non-abstainers, and as transfers from one class to the other have been excluded from both classes, we have a body of evidence which gives irrefutable proof of the longer life enjoyed by the

abstainers. Up to the age of 55 the death-rate of non-abstainers at any age is never less than 45 per cent higher than that of abstainers, and at some ages 94 per cent higher than the latter. Between 60 and 64 it is 32 per cent higher; between 65 and 69 it is 20 per cent higher; between 70 and 74 it is 16 per cent higher than that of abstainers, so that the superiority of the latter persists at nearly every age. Expressed in another way, every abstainer 30 years of age has an average prospect of living $3\frac{1}{10}$ years longer than a non-abstainer. Comparing with more general experience, out of every 100,000, starting at the age of 20, among the abstainers 53,044 reach the age of 70, while only 42,109 reach this age in the general experience of a large number of life offices of Great Britain.

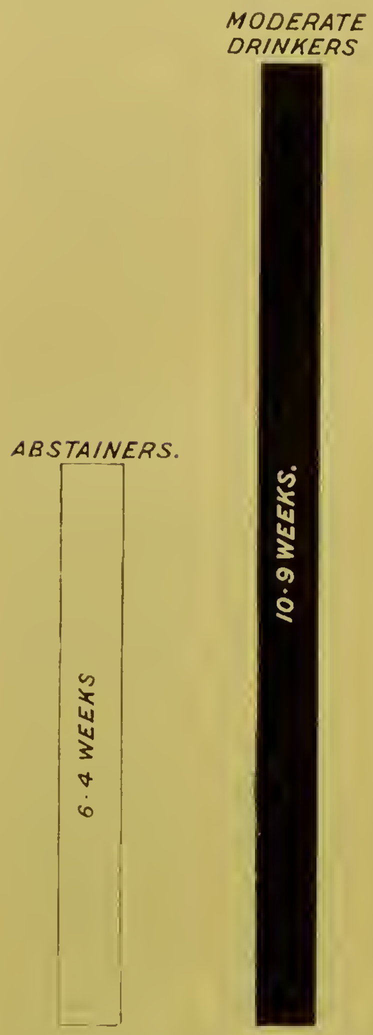

FIG. 20.—To show the facts derived from insurance statistics, which demonstrate that the moderate drinkers of alcohol make calls upon their sick fund for many more weeks than do the total abstainers.

It is not necessary to multiply similar figures. All point to the same conclusion. The prospects of long life, like the prospects of good health, are very

seriously diminished by alcoholic indulgence. Of course the non-abstainers in the statistics quoted above comprise a certain proportion of drunkards, and it may be urged that it is the latter who cause this enormous difference in life prospects between abstainers and non-abstainers. There must have been

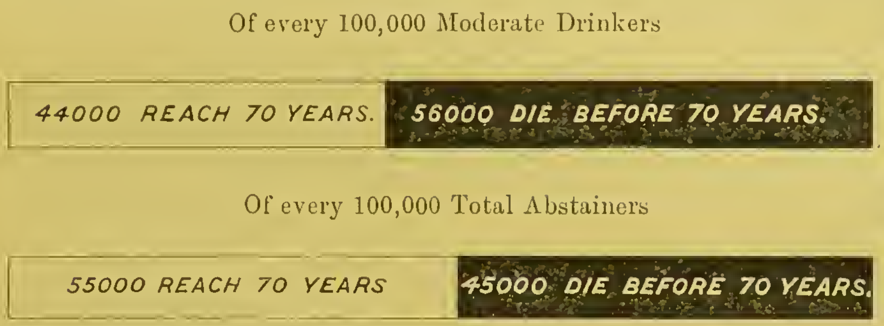

Fig. 21.—Comparison between the duration of life of total abstainers and moderate drinkers. (From a paper read by Mr. R. M. Moore before the Institute of Actuaries 30.11.03.)

a large number of drunkards, if they alone caused the experienced difference, and this is contrary to the known facts. We are compelled to conclude that what is commonly described as moderate drinking has a most injurious influence on health and life, and that the best practice, both in the interests of health and morality, consists in the avoidance of all alcoholic drinks as a beverage.

GLOSSARY

Absolute Alcohol. Pure alcohol; alcohol without water.

Adolescence. The transition period from childhood to manhood.

Albumin. The general name for the chief constituent of protoplasm.

Albuminoid. A substance resembling albumin.

Albuminuria. A diseased condition in which albumin passes out of the body with the urine.

Alimentary. Pertaining to *aliment* or food; *alimentary canal,* the mouth, gullet, stomach, and intestines.

Amblyopia. Dimness of sight neither arising from defects in the cornea nor in the humours of the eye.

Anæsthetics. Drugs which produce insensibility to pain.

Aphthous. Affected by *aphthæ*; fungous patches on mucous membrane.

Arteriole. A small artery.

Aseptic, antiseptic. A condition (often brought about by surgical treatment) whereby germs are excluded or destroyed.

Astringent. A substance which causes the tissues of the body to contract.

Atony. Want of tone. See *Tonic.*

Autopsy. Dissection of a corpse for the purpose of examination.

Bacilli, bacteria. Microscopic germs which are the causes of fermentation and of disease.

Calcification. The process whereby degenerated tissues become hardened and brittle owing to the deposition of lime salts.

Carbo-hydrates. Food-stuffs, like *starch* and *sugar*, which are composed of carbon, hydrogen, and oxygen.

Cardiac. Belonging to, or relating to the heart, *e.g. cardiac weakness.*

Catarrh. Inflammation of a mucous membrane accompanied by secretion of mucus.

Cerebritis. Inflammation of the *cerebrum,* or larger brain.

Chronic. Continuing, or habitual, *e.g. chronic alcoholism.*

Chronograph. An instrument for measuring and recording intervals of time.

Cirrhosis. Fibrous degeneration of an organ.

Clinic, clinical. Pertaining to the study of disease by the bedside.

Clinician. One who studies disease by the bedside.

Coagulate. To clot.

Coma. A state of profound insensibility.

Congestion. A distension of the blood-vessels commonly associated with inflammation.

Consanguinity. Relationship by birth.

Convoluted. Having *convolutions,* or folds.

Co-ordinate. To regulate and combine movements, *e.g.* "*the brain's power of co-ordinating*" bodily movements.

Corpuscles. Protoplasmic cells.

Corrugated. Wrinkled with alternate ridges and grooves.

Cortex. The outer layer of an organ, *e.g. cerebral cortex.*

Cultures. Masses of germs or microbes grown artificially in suitable liquids.

Dehydration. The process of removing the water which forms part of a substance.

Dementia. A form of insanity involving loss of mental power.

Dextrin. A gummy substance formed by heating starch.

Diagnose. To recognise the cause and nature of a disease.

Diastase. A ferment found in grain when it begins to sprout, and which turns the starch into sugar.

Dietetic. Relating to *diet*: *dietetics*, the branch of medical science which deals with diet.

Dilatation. The enlargement of an organ by expansion.

Effete. Worn-out, dead.

Elimination. Separating out, getting rid of.

Embryo. The germ or beginning of plant or animal.

Enzyme. A chemical substance which may be a ferment or the precursor of a ferment. See *Ferment.*

Epithelial. Belonging to the *epithelium*, the layers of cells forming the outer surface of the skin and mucous membrane.

Ergograph. An instrument for experimentally estimating the work done mechanically by certain muscles.

Erythema. Congestion of the skin.

Etiology. The scientific investigation of the causes of disease.

Excoriation. Stripping or tearing off the outer skin.

Excrete. To separate and discharge from the body what is useless.

Ferment. A body which has the property of chemically splitting up complex organic substances.

Ganglia. Small masses of grey nerve tissue, consisting chiefly of groups of nerve corpuscles.

Germinate. To sprout, shoot, begin to develop.

Glucose. A sugar found in ripe grapes and honey.

Glycosuria. The condition of the body in which *glucose* (sugar) is discharged with the urine.

Hæmorrhage. Bleeding.

Hallucination. A condition of mental delusion, in which the patient appears to see, hear, or feel things which do not exist in reality.

Hypodermic. That which is under the skin.

Ideation. The mental process of forming ideas.

Idiosyncrasy. The peculiar attribute of an individual.

Illusion. A wrong mental impression, a mental deception.

Inertia. Want of activity, sluggishness.

Ingestion. The act of taking into, or putting into the stomach.

Inhibition. The act of restraining or checking.

Inhibitory. Restraining or checking.

Immunity. Freedom from danger of contagion.

Immunisation. The process of making *immune*.

Lactation. The action of the breast in secreting and yielding milk.

Lesions. Any diseased change in the structure of an organ.

Lethal. Deadly, fatal.

Litre. The unit of the metric measure of capacity: a litre $= 1\frac{3}{4}$ pints (nearly).

Leucocytes. White corpuscles.

Lymphatics. A net-work of delicate vessels mixed up with the smaller blood-vessels, and containing *lymph*.

Mammals. Animals which suckle their young.

Medullation. The process whereby, in development, the nerve fibres become covered with a sheath.

Medusæ. Jelly-fish.

Meningitis. Inflammation of the membranes of the brain and spinal cord.

Metabolism. "The normal, healthy chemical changes going on in the body as a whole." See Chap. XIII.

Metamorphosis. Change of form, change of material from one kind to another, *e.g. fatty metamorphosis.*

Microbes. The microscopic organisms which are the germs of disease.

Micro-organisms. Microscopic forms of life.

Mobility. The state of being *mobile*; that is, capable of being moved.

Morbid. Relating to disease; diseased.

Narcotics. Drugs which cause sleep and insensibility.

Neurosis. An impaired condition of nervous function.

Neurotic. Subject to nervous disorders.

Nitrogenous. Containing *nitrogen.*

Normal. According to rule, healthy, natural.

Obese. Fat, stout.

Obfuscation. Indistinctness, bewilderment, *e.g.* "*mental obfuscation.*"

Ovulation. The formation and discharge of *ova* or eggs.

Oxygenation. The process of combining with *oxygen.*

Pathologist. One skilled in pathology.

Pathology. The part of medical science which treats of the processes underlying disease.

Pepsin. The ferment in the gastric juice which helps to digest the *proteids.*

Peptic. Relating to digestion; "*peptic glands,*" the principal glands of the stomach that secrete gastric juice.

Peripheral. That which belongs to the outside or parts distant from the centre, as opposed to what is central.

Pharmacology. The knowledge of drugs and the preparation of medicines. *Pharmacologist,* one skilled in drugs.

Pharmacopœia. An authoritative list of drugs and of the modes of preparing them.

Pharyngitis. Inflammation of the *pharynx,* the back of the mouth.

Phylloxera. A small insect which destroys the roots and leaves of the grape-vine.

Potassa. Potash.

Precipitation. The act of *precipitating,* or throwing down a solid from a solution.

Processes. Small projections growing out from a living cell.

Proliferation. The continuous growth and development of cells.

Proteids. The scientific name given to albuminous substances.

Protoplasm. The living substance out of which all living cells are built up.

Pseudæsthesia. Imaginary feelings, *e.g.* such as are referred to an amputated limb.

Psychic. Mental, pertaining to the mind.

Reflex action. A movement produced by the brain or the spinal cord in consequence of some impression received from the outside and without the action of the will.

Sedative. Tending to calm.

Senile. Belonging to old age.

Septic. Having power to cause putrefaction and disease.

Sociology. The science which treats of the origin and development of human society.

Subjective. Pertaining to one's own consciousness.

Sympathetic. Belonging to the sympathetic nervous system.

Therapeutics. The part of medical science treating of the use of remedies.

Thoracic. Belonging to the *thorax*, or chest.

Tolerance. The power of taking doses of a drug which, ordinarily, would be hurtful or fatal.

Tonic. Relating to *tone*; the healthy and vigorous condition of an organ, *e.g. the tonic state of a muscle.*

Toxic. Poisonous.

Tuberculosis. A microbic disease in which the bacillus causing it evokes the formation of nodules of *tubercles* in the tissues.

Utopian. Fanciful, imaginary, *e.g. utopian view of alcohol.*

Vascularity. The condition of being richly supplied with blood-vessels and blood.

Viable. Born alive and capable of living.

Volition. The will.

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